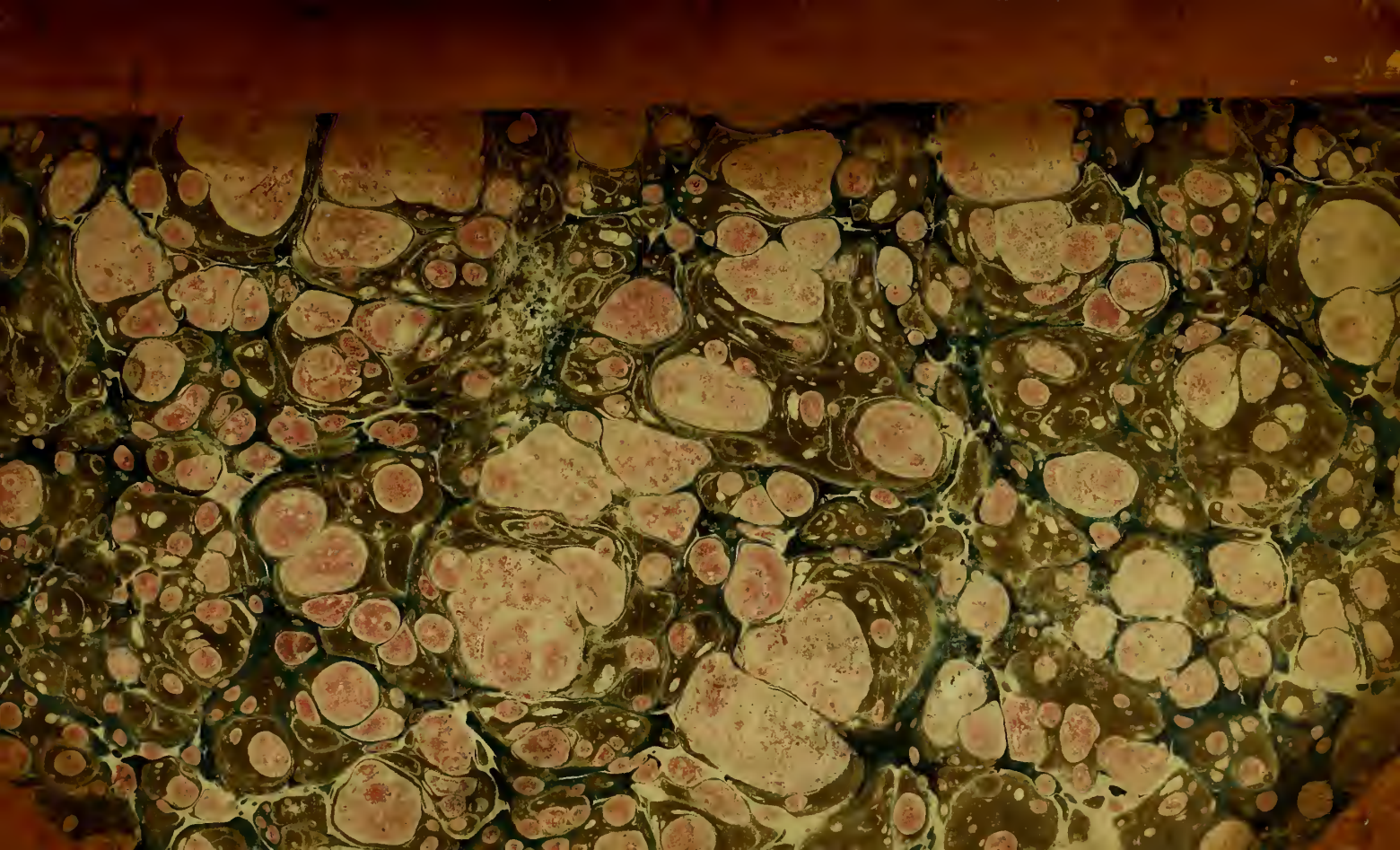

OUTLINES

OF

MINERALOGY,

TRANSLATED

FROM THE ORIGINAL,

OF

SIR TORBERN BERGMAN,

KNIGHT OF THE ORDER OF WASA,

PROFESSOR OF CHEMISTRY AT UPSAL, &c.

BY WILLIAM WITHERING, M. D.

MEMBER OF THE ROYAL MEDICAL SOCIETY,

AT EDINBURGH.

Itum eſt in viſcera terræ;
Quaſque recondiderat ſtygiiſque admoverat umbris
Effodiunter opes, irritamenta malorum.

OVID.

BIRMINGHAM:

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M, DCC, LXXXIII.

TRANSLATOR's

PREFACE.

THE pleaſure and inſtruction I received myſelf from this excellent little work of Profeſſor Bergman, inſpired me with a wiſh to make it more generally known to others. A ſyſtem like this, founded upon the conſtituent principles of things, may be improved, but never can be exploded. Engliſh names are given, but the Latin ones of the original are ſtill retained, as an acquaintance with them will enable the reader more readily to conſult other authors. Blank ſpaces are left after moſt of the ſpecies, for the convenience of inſerting any new ones that may occur. I have added a few new ſpecies,

and ſome notes; the utility of which will be ſufficiently obvious. The table of metals, at page 71, and the index at the end, will alſo, I hope, be conſidered as uſeful additions.

BIRMINGHAM,
1ſt September, 1783.

N. B. The centnary *(centenarius)* of PROFESSOR BERGMAN is equal to 60 Swediſh grains, or nearly 63 Engliſh grains.

THE

AUTHOR's PREFACE.

IN compliance with the requeſt of my learned and amiable friend, the celebrated Mr. Ferber, I tranſmitted to him a ſlight ſketch of mineralogy, in which the ſubjects were arranged according to their conſtituent or component parts. After peruſing it, he requeſted my permiſſion to publiſh it. At firſt I thought it better to ſuppreſs a work that was ſo imperfect, eſpecially when I conſidered the number of analyſes that yet remained to be made. He replied, that a perfect method was not yet to be expected in a ſubject ſo extenſive, but that having once laid a good foundation, I might occaſionally make ſuch additions and corrections, in new editions of the work, as future experiments might render neceſſary. Indeed, I was fully aware, that the ſyſtem would ſooner be rendered perfect, if ſubmitted to the inſpection of other more diſcerning chemiſts, than if the completion of it reſted upon myſelf only. The different remarks of others, will correct er-

A rors

rors, which, by a further attention, I might have amended; but if the intereſt of ſcience be promoted, no matter by whom.

This little work contains GENERA and SPECIES, except in the appendixes, which, as not properly belonging to my deſign, contain Genera only.

The GENERA are founded upon the prevalent component parts; the SPECIES upon the diverſity of the compoſition. *Varieties* depend upon external appearances, and therefore are at preſent omitted.

After this manuſcript was ſent away, I diſcovered two ſpecies of *ſtannum ſulphuratum* (tin combined with ſulphur), one of which contains about forty per cent. of ſulphur, the other only twenty. The firſt has the appearance of aurum muſivum; the latter partly reſembles *antimonium ſulphuratum* (crude antimony), but does not contain antimony. Both are contaminated by a ſmall quantity of copper. I got them from Nerchinſkoi in Siberia *.

* In this tranſlation they are introduced in their proper places. W.

As

As to the TERRA PONDEROSA (heavy earth), I have long been aware of its great reſemblance to calx of lead, and have even lately found a method of precipitating it by the phlogiſticated alkaly *; ſo that I verily believe it to be of a metallic nature, although it has never yet been made into a regulus, and, therefore, I ſtill place it with the earths, until its ſituation be better aſcertained.

If providence allots me life and health, I hope, a few years hence, to republiſh this imperfect ſketch, corrected and enlarged.

* There is no difficulty in doing this: either the foſſil, or the vegetable fixed alkaly phlogiſticated, precipitate the terra ponderoſa, inſtantly and entirely, out of the nitrous, muriatic, or vegetable acids. W.

OF A

NATURAL SYSTEM

OF

MINERALOGY.

§ 1.

THE MINERAL KINGDOM conſiſts of the foſſil ſubſtances found in the earth. Theſe are either entirely deſtitute of organic ſtructure, or, having once poſſeſſed it, poſſeſs it no longer: ſuch are the petrefactions.

§ 2.

It is requiſite, for the proper diſcrimination of foſſils, to eſtabliſh certain characters, whereby they may, at all times, and in all places, be diſtinguiſhed from one another. The ſcience that teaches theſe is called MINERALOGY.

§ 3.

As in the vegetable kingdom different methods have been formed upon the roots, the leaves, the flowers, the fruit, &c. ſo alſo in Mineralogy many

many methods may be deviſed, and there is no doubt of the utility of contemplating inorganic bodies in every point of view; for the more compariſons are multiplied, the more evidently do reſemblances or differences appear.

§ 4.

But as the chief object of the ſcience is to render foſſils ſubſervient to the uſes of man, it is evident that that method muſt be the beſt which diſplays their component parts: for theſe being well underſtood, we know what to expect from them; we accommodate our deſigns to their nature, and ſpend not our labour and money in vain attempts inconſiſtent with their inherent qualities.

§ 5.

There is a power implanted by the creator in organized bodies, which, upon the acquiſition of proper nutriment, unfolds and evolves the ſtructure which before lay concealed in the fecundated egg or ſeed. Similar veſſels, in each ſpecies, abſorb, convey, and aſſimilate the nouriſhment in the ſame manner; ſo that the appearance and ſtructure remain the ſame, unleſs peculiar cauſes prevent the accuſtomed courſe of things, and produce monſters: but this very rarely happens. Hence it is that the leading features or the external parts agree with the internal properties, and

and when judiciouſly choſen, form ſufficient characteriſtic diſtinctions.

§ 6.

But the formation of foſſils is totally different. Here no ſyſtem of veſſels collects, diſtributes, ſecretes or changes the concurrent particles, but they run together by chance, and are ſolely connected by the power of attraction; they are generally, too, of different kinds, rare and denſe, figured and ſhapeleſs, admitting of every poſſible variety. This general view of the ſubject ſhews us how little external characters can be depended on; but we ſhall more particularly conſider the principal of theſe.

§ 7.

Colour varies exceedingly, as does alſo the ſize of bodies. We cannot ſufficiently wonder at the violence done to nature by the ſtudied ſeparation of earths from ſtones. The conſequence is, that a ſtone of a certain ſize muſt conſtitute one genus, whilſt the ſame thing, reduced to powder, muſt be placed under another genus, which ſhall not be found even in the ſame claſs.

§ 8.

Hardness not unfrequently varies even in the ſame ſpecimen. Soft clay dries in the fire, and at length acquires the hardneſs of flint. Steatites *(ſoap-rock)* which may be ſcraped with the nail, and

and many other matters harden in the ſame manner, and that ſometimes without any notable loſs of weight; ſo that bodies paſs through every different degree of hardneſs, without any other change of their mixture.

§ 9.

Texture, and external form of the particles, may ſeem at firſt ſight to depend more upon the conſtituent parts; but a calcareous particle, globular or ſhapeleſs, is found, upon the moſt ſcrupulous examination, to poſſeſs the ſame properties as a piece of ſpar; and in another place I have clearly ſhewn, that the ſchirl-like, garnet-like, hyacinthine, twelve-ſided, and other figures, are not unfrequently formed by nature out of the ſame materials *. And if we are liable to deception where ſo great a difference in external forms exiſts, what can we expect from leſs conſtant external qualities?

§ 10.

Superficial characters are therefore inſufficient. They cannot even enable us to diſtinguiſh calcareous from other earths, for the effervescence with acids is a chemical mark, and happens, too, in matters of very different natures. To paſs

* Opuſc. chemica, vol. II. page 2---10.

over

over other inſtances, let him who is able diſtinguiſh the plumbum aeratum and plumbum phoſphoratum (§ 182. § 183.) by external appearances only!

§ 11.

But let us not altogether deſpiſe external characters: it is of moment to know and mark them well*. They frequently enable the accuſtomed eye without troubleſome trials to acquire a degree of certainty, which wants only a few ſelect experiments to confirm it. Sometimes alſo the uſe depends upon external properties, evident to our ſenſes, as the hardneſs, the colour, the pellucidity, &c. Theſe therefore may with propriety be joined to thoſe which point out the conſtituent principles.

§ 12.

Claſſes, Genera and Species are therefore to be formed upon the internal nature and compoſition; the varieties upon the external appearances. In ſuch a ſyſtem both methods conveniently agree.

§ 13.

Cronstedt firſt attempted this method, and with great ſucceſs; but afterwards the *liquid*

* Conſult particularly Dr, Werner's treatiſe on the *external characters of foſſils* printed in German in the year 1774.

analyſis

analyſis, in which the illuſtrious MARGRAAF took the lead, better opened the internal ſecrets of nature; ſo that the excellent work of Cronſtedt now appears to contain many errors; theſe however are not to be attributed to any fault in the author, but to the inſufficiency of his experiments. The attempts of Mr. Pott by fuſion have long been known; but theſe however uſeful in other reſpects, rather tend to confound than to lay open the component parts of bodies.

§ 14.

In methodizing foſſils, *compounds ſhould rank under the moſt abundant ingredient.* Thus let *a* and *b* repreſent the component parts; if the former be the heavier, the compound muſt be placed under the genus of that: but this rule admits of ſeveral exceptions.

§ 15.

Thus, the *properties of all ingredients are not of the ſame intenſity*, if I may be allowed the expreſſion; ſome are more powerful or efficacious, ſo as to impreſs the maſs with their own genus and character, though forming *leſs* than half the weight. In ſuch a caſe the qualities are rather to be conſidered than the quantity, eſpecially if *b* ſo far from preponderating hardly ever amounts to half the weight.

§ 16.

Argillaceous earth *(earth of allum)* and magneſia are never found ſeparate, but almoſt always mixed

mixed with other things ſo that their weight conſtitutes the ſmaller part of the maſs: therefore if the above rule (§ 14.) was rigouroufly adhered to, theſe primitive earths would not be found amongſt the Genera, which would doubtleſs be an abſurdity.

§ 17.

The *value* of a thing muſt likewiſe be conſidered. Minerals containing gold or ſilver muſt be ranked with thoſe noble metals although they hold three, four, or more times the quantity of heterogeneous matter. Not to mention other examples, pyrites are placed under the genus copper although they contain a much greater quantity of iron. This cuſtom, eſtabliſhed with the univerſal conſent of mineralogiſts, wants indeed a natural foundation, but it ſeems uſeful to miners to retain it; and the more ſo as it is certain that otherwiſe many minerals would be to be ſought for under ſtrange and improper titles.

§ 18.

Laſtly, it muſt be remarked, that *the ſolid ingredient determines the genus* although the menſtruum be greater in quantity. Thus in magneſia vitriolata *(Epſom ſalt)* the earth gives the Generic name, although the vitriolic acid be the more ponderous. The ſame holds good in gypſum, allum, &c.

CLASSES

CLASSES OF FOSSILS.

§ 19.

FOSSILS are of four kinds, viz. *ſaline*, *earthy*, *inflammable*, and *metallic*; hence ariſe four claſſes.

§ 20.

SALTS, or ſaline ſubſtances are more or leſs ſapid, and when finely powdered diſſolve in at leaſt 1000 times their weight of boiling water. They melt in the fire, which for the moſt part changes or deſtroys them*.

§ 21.

EARTHS are inſipid, not ſoluble in water in the degree mentioned above (§ 20) though

* The latter part of this definition does not apply perfectly well to ſome of the ſimple ſalts. I ſhall therefore offer another, given by Dr. Cullen, viz. "*Saline bodies* "are ſapid, miſcible with water, and not inflammable." I am ſenſible too that this definition is not perfectly unexceptionable, ſince it has been found that vol. alkaly in an aerial ſtate is in a certain degree inflammable. W.

perhaps

perhaps water in Papin's digeſtor will diſſolve ſome if not all of them, eſpecially if their ſurface be greatly increaſed by a previous ſolution in and precipitation from ſome other menſtruum. In the chain of nature they are by inſenſible gradation joined to the ſalts, ſo as not to be diſtinguiſhed without artificial limits. Their form is not changed by a moderate heat, nor are they diſſipated by a violent one. Their ſpecific gravity is to water, leſs than 5 to 1.

§ 22.

INFLAMMABLE foſſils abound with phlogiſton, do not unite with water, but when pure diſſolve in oils; expoſed to the fire, they ſmoke, generally inflame, are for the moſt part conſumed, and ſometimes totally vaniſh.

§ 23.

METALS when perfect do not diſſolve at all in water; only a few of them in oils, and then only when in part deprived of their phlogiſton. They are the heavieſt of all known ſubſtances, the lighteſt of them weighing more than ſix times its bulk of water.

They melt in the fire with a ſhining ſurface, and in clay veſſels the ſurface is convex.

CLASS

CLASS I.

SALTS.

§ 24.

WE begin with the nature and properties of ſaline bodies, for unacquainted with theſe our knowledge of other bodies muſt be exceedingly imperfect. *Native ſalts* are either *acid*, *alkaline*, *neutral*, *earthy* or *metallic*.

§ 25.

ACIDS may be diſtinguiſhed by their proper taſte; they effervesce with mild alkalies; and change the blue juices of vegetables and tincture of heliotropium to a red colour*.

We are acquainted with many ſpecies of acids, but they are hardly ever found pure in the bowels of the earth, nor can we expect to find them ſo when we conſider how ſoon ſuch powerful men-

* As the tincture of heliotropium is the niceſt known teſt of the preſence of an acid, it may not be amiſs to mention that it may be had from dyers under the name of litmus. It is very cheap, and generally requires to be greatly diluted with diſtilled water before it can be uſed. W.

ſtrua

ſtrua muſt meet with ſubſtances to ſaturate them. Their great abundance and their properties ſhew their various and indiſpenſible uſes in the œconomy of nature.

§ 26.

As mineralogy treats of thoſe bodies which are found under the ſurface of the earth, and as acids in an uncombined ſtate are not found there, it would ſeem proper to exclude them; but the ſame reaſon would likewiſe exclude the primitive earths, ſome of which have never yet been found pure. Therefore in a ſyſtem formed upon the component parts of bodies, a ſhort deſcription of the principal of theſe is not to be diſpenſed with, although they hardly ever preſent themſelves in a ſeparate ſtate.

§ 27.

Vitriolic ACID. When moſt concentrated by artificial means its ſpecific gravity is 2, 125. When pure, has neither colour nor ſmell. Cold ſometimes though very rarely concretes it into a ſolid form; it may be coagulated by nitrous air. This as well as the other acids is beſt known from the compounds it forms with other ſubſtances.

Mr. VANDELL † ſays that it is ſometimes mixed with the ſtreams from the hills in the neighbourhood of Sienna and Viterbo, raiſed no doubt

† De thermis patavinis.

by

by ſubterranean fires; but in general it is united to alkalies (§§ 44, 47, 50,) to earths (§§ 58, 59, 63, 67,) to metals (§§ 69, 70, 72, 73,) or to phlogiſton (§§ 134, 136.)

Phlogiſticated vitriolic ACID (volatile vitriolic acid) is frequently thrown out by the craters of volcanoes; its ſmell ſuffocating and penetrating. The union to phlogiſton and the matter of heat gives it an aerial form, but does not prevent its union with water.

§ 28.

Nitrous ACID is by ſome excluded from the foſſil kingdom, becauſe they ſuppoſe it to be produced from the putrefaction of organic bodies. But theſe bodies when deprived of life are again received amongſt the foſſils, from whence their more fixed parts were originally derived.

In the moſt concentrated ſtate that art can procure it, its ſpecific gravity is 1, 580. Colourleſs when pure; but its ſtrong attraction to phlogiſton renders particular management neceſſary to procure it ſo *. With different proportions of phlogiſton it forms phlogiſticated acid and nitrous air.

* The moſt highly coloured and fuming nitrous acid may readily be rendered colourleſs by boiling it haſtily in an open veſſel. Part of the acid flies off, carrying the ſuperabundant phlogiſton along with it, in the form of nitrous air. W.

It

It has never as far as I know been met with diſengaged, unleſs perhaps in water precipitated out of the atmoſphere, but is found united to alkalies (§§ 45, 47, 51) or to earths (§§ 60, 64.)

§ 29.

Muriatic ACID (ſpirit of ſalt) is found in great quantity at and under the ſurface of the earth. The ſtrongeſt prepared by art hardly attains a ſpecific gravity of 1, 150. It has a very peculiar and volatile ſmell. Deprived of its ſuperfluous water it aſſumes an aerial form, for phlogiſton ſeems to be one of its conſtituent parts*.

It has never been found uncombined (unleſs perhaps like the nitrous acid in water precipitated from the atmoſphere†) ‡ but united to alkalies (§§ 46, 49, 52), to earths (§§ 61, 65), or to metals (§§ 74, 161, 175, 191).

§ 30.

Fluor ACID, is obtained by art; its ſpecific gravity never exceeds 1,500, it is very volatile. Its vapours when hot, corrode glaſs; and meeting with moiſture generate, or at leaſt depoſit ſiliceous earth. When deprived of its ſuperfluous water it aſſumes an aerial form ‖. It has

* N. Acta Upſ. vol. II. p. 202. † M. Margraaf.

‡ I have ſome reaſon to believe that the Nevil Holt water does contain ſome of this acid in an uncombined ſtate. W.

‖ Opuſcul: vol. II. p. 40.

never been found diſengaged, but united to calcareous earth forming ſparry fluor† (§ 96) and if I am not miſtaken it enters into the compoſition of ſiliceous earths.

§ 31.

Arſenical ACID, dry; prepared by art; ſpecific gravity 3, 391; fuſible and fixed in the fire, until it acquires from the matter of heat ſo much phlogiſton as is neceſſary to convert it into white arſenic. In a moiſt air it deliqueſces.

It is not found uncombined, but united to calx of cobalt (§ 228), and alſo to phlogiſton, forming a brittle arſenical metal (§ 220), and its calx (§ 222).

§ 32.

Molybdæna ACID. This is very probably of metallic origin, though it does not yet appear to which metal it belongs. Seeing that arſenic, a brittle metal, by dephlogiſtication only is changed into an acid, different from all other acids, it is not improbable that other metals may have an acid baſis, although their phlogiſton adhering more ſtrongly has not yet been completely ſeparated.

† Called Derbyſhire fluor; Corniſh fluor, blue John. W.

How

How this ſubſtance may be obtained by art does not belong to this place to deſcribe *; but that the acid got from Molybdæna has a metallic nature, and as yet has not been perfectly freed from phlogiſton, is probable from the following conſiderations. 1, Its taſte is acid and at the ſame time metallic. 2, Microcoſmic ſalt and borax are coloured by it, and theſe ſalts are hardly coloured by any thing but metallic calxes. 3, Its decompoſition by means of the phlogiſticated fixed alkaly, which always indicates the preſence of a metal. 4, Its concrete form, and not deliqueſcing, analogous to white arſenic. 5, Its ſpecific gravity 3,460. And very lately M. Hielm by my perſuaſion attempted the reduction and obtained a regulus, ſeemingly different from every other metal, but not yet ſufficiently examined.

§ 33.

An acid conjoined to the calx ponderoſa (*ponderous calx or lime*) is nearly allied to the preceding, but dropped into lime water produces a different compound, though in a number of other circumſtances theſe two acids agree. I apprehend that this is likewiſe of a metallic nature.

* D. Scheele Act. Stockh. 1778.

§ 34.

Phosphoric ACID, evidently exists in the animal kingdom, * much more plentifully in the vegetable, but in the fossil very rare. Mr. J. G. GAHN first detected it united with lead; † but probably it may be found in many other fossils. It is fusible in the fire. Its specific gravity when deprived of water 2, 687.

§. 35.

Boracic ACID, (*acid of borax, or sedative salt.*) Many people still think this to be an artificial production, but not long since Mr. HOEFER ‡ found it in a lake near Sienna in the great dutchy of Hetruria, and it has long been known to be united to the fossil alkaly in native borax. It acts like an acid, though very feebly. It melts in the fire and volatilizes with water. Its specific gravity is 1, 480.

§ 36.

Amber ACID, is a concrete salt obtained from amber; it acts like a feeble acid. It is yet doubtful whether amber be of vegetable origin; many reckon it fossil.

* It has been lately obtained in great abundance from bones. W.

† Opusc. chem. vol. II. p. 424.

‡ De Sale sedativo naturali, 1778.

§ 37. *Aerial*

§ 37.

Aerial ACID (*fixed air*) is not only combined with water but with many other foſſil ſubſtances, as alkalies (§§ 54, 56), earths (§§ 62, 66), and with ſome metals (§§ 71, 183, 192, 217, 234, 243). It floats uncombined in the atmoſphere. Its ſpecific gravity 0, 0018†.

§ 38.

ALKALIES are known by their peculiar lixivial taſte, by their vehement attraction to acids, and by their changing the blue colours of vegetables to a red. In a pure ſtate, as was before obſerved of acids, their attraction to other ſubſtances is ſo ſtrong that they cannot long remain uncombined; and if other acids were wanting, the aerial acid, every where preſent in the atmoſphere, would unite with them: therefore they are always found in a ſtate of combination, unleſs prepared by art.

§ 39.

New acids are daily detected, but no additions have been made to the three ſpecies of alkaly long ſince known.

§ 40.

Vegetable fixed ALKALY, deprived of every acid is not found on the face of the earth; but it is ſometimes met with in combination with the

† It is found in a ſeparate ſtate in large quantities in ſome of our mines and wells, and is called the *choak* damp. In the famous Grotto del Cano too it exiſts tolerably pure. W.

vitriolic acid (§ 44) or the muriatic (§ 46), generally with the nitrous, (§ 45) rarely with the aerial (§ 54).

§ 41.

Foſſil fixed ALKALY is only found in combination with acids, rarely with the vitriolic (§ 47) or nitrous (§ 48), principally with the muriatic (§ 49) or aerial (§ 55).

§ 42.

Volatile ALKALY is frequently found in clays, doubtleſs in a mild ſtate, for the help of art is required to render it cauſtic. It is alſo found united to the vitriolic (§ 50) and the muriatic acids (§ 52.)

§ 43.

ACIDS united to *alkalies* form NEUTRAL SALTS. Theſe diſſolved in water are no ways diſturbed by the addition of an alkaly, and generally by evaporation concrete into cryſtals. If by proper teſts they ſhew neither acid nor alkaline properties they are ſaid to be *perfect* neutrals, but *imperfect* when from defect in quantity or ſtrength of one ingredient the peculiar properties of the other more or leſs prevail.

We now proceed to conſider the native ſalts of both kinds.

NEUTRAL

NEUTRAL SALTS.

§ 44.

ALKALI *vegetabile vitriolatum* (tartar of vitriol) ſeldom occurs ſpontaneouſly, unleſs where tracts of wood have been burnt down.

§ 45.

ALKALI *vegetabile nitratum* (common nitre) forms upon the ſurface of the earth where vegetables, eſpecially when mixed with animal ſubſtances, putrify. The alkaline baſis previouſly exiſts in the plants *, but the origin of the acid is not ſo well underſtood: whether it lies concealed in the vegetable acid, and by means of the putrefactive proceſs ſufficiently dephlogiſticating it, is evolved; or whether the purer part of the atmoſpheric air contains nitrous acid *fully* ſaturated with phlogiſton, which ‡ upon the alkaly being ſeparated bythe putrefaction is attracted and extricated by it, and upon loſing its inflammable principle aſſumes its accuſtomed form. Nature perhaps operates in both ways; the latter however ſeems clearly confirmed by a very remarkable experiment (§ 60.)

* D. D. MARGRAAF, WEIGLEB.

‡ Opuſc. chem. vol. II. p. 368.

As nitre is annually produced in large quantities, it cannot but ſometimes be found in ſprings or wells, as has been obſerved at Berlin *, London †, and elſewhere ‡. Sometimes it abounds in ſuch quantities that fleſh boiled in theſe waters turns red.

§ 46.

ALKALI *vegetabile ſalitum* (digeſtive ſalt) is ſometimes though rarely met with; generated perhaps by the deſtruction of animal and vegetable ſubſtances.

§ 47.

ALKALI *minerale vitriolatum* (Glauber's ſalt) is ſometimes found in waters. Some of the lakes in Siberia and Aſtracan contain it, and many ſprings in other places.

§ 48.

ALKALI *minerale nitratum* (cubic nitre) rarely occurs but where maritime plants putrify.

§ 49.

ALKALI *minerale ſalitum* (common ſalt) plentiful every where as well in the earth, where it

* Margraaf Opuſc.

† Cavendish Phil. Tranſ. 1767.

‡ Dr. Home, in his eſſay on bleaching, ſays it is found in coal mines in this iſland, and a friend aſſures me that he has obtained it from the water iſſuing out of coal pits. W.

forms

forms ſtrata more or leſs thick (ſal gem), as alſo diſſolved in ſprings and lakes, and in the ſea. (ſea ſalt.)

§ 50.

ALKALI *volatile vitriolatum* (vitriolic ammoniac) is ſcarcely found any where but in places where the phlogiſticated fumes of vitrolic acid ariſe from burning ſulphur, and in putrid places are abſorbed by the volatile alkaly.* Thus at Fahlune the acid vapour from the roaſted minerals produces this ſalt in the neceſſary houſes. It is ſometimes alſo formed in the craters of volcanoes.

§ 51.

ALKALI *volatile nitratum* (nitrous ammoniac) is generally found along with common nitre.

§ 52.

ALKALI *volatile ſalitum* (ſal ammoniac or common ammoniac.) I have examined ſome from Veſuvius, and ſome from the Solfaterra near Naples.

* As volatile alkaly may be obtained in large quantities from pit coal, and produced by proceſſes not dependant upon putrefaction, there is reaſon to believe that the vitriolic ammoniac may be formed in ſeveral ways not noticed by the author. W.

The

The ſalts hitherto enumerated are perfect neutrals, thoſe which follow are imperfect (§§ 53, 56.)

§ 53.

ALKALI FOSSIL, only in part ſaturated with a peculiar acid is called tinkal; after depuration, borax. It is dug out of the earth in the kingdom of Thibet *. Borax takes nearly an equal weight of acid before the alkaline properties entirely diſappear †.

I believe no one has yet found the acid of borax united either to the vegetable or volatile alkalies.

§ 54.

ALKALI VEGETABILE *aeratum* (mild vegetable alkaly) is hardly ever found native, unleſs in the neighbourhood of woods deſtroyed by fire.

In the year 1774, at Douai in Flanders, a ſpring was diſcovered ſurrounded by a wall, whoſe waters, beſides other impregnations, contained 11 grains of vegetable alkaly in a pint ‡.

* Acta Stockh. 1772.

† From ſome experiments lately made I found that both tinkal and purified borax, required twice their weight of ſedative ſalt, to neutralize them perfectly ſo that they would no longer change vegetable blues to a green. W.

‡ Baumé mem. des ſc. etr. tom. iv.

§ 55. AL-

§55.

ALKALI MINERALE *aeratum* (mild foſſil alkaly, natron, the nitre of the ancients) is found plentifully in many places, particularly in Africa and Aſia, either concreted into chryſtallized ſtrata, or fallen to a powder; or effloreſcing on old brick walls, or laſtly, diſſolved in ſprings. It frequently originates from decompoſed common ſalt. I am not ignorant that the acid of common ſalt adheres ſtrongly to its baſis ſo as not to be expelled by fire; but perhaps the viciſſitudes of the atmoſphere continually acting for ages, may be more powerful. In immenſe plains covered over with this alkaly, ſcarcely any common ſalt is found upon the ſurface, but the deeper you dig the more it is contaminated by it, the common ſalt being yet undecompoſed for want of acceſs of air.

§56.

ALKALI VOLATILE *aeratum* (mild volatile alkaly) has been found in pump waters in London*, in Lauchſtadt†, at Frankfort on the Mayne‖, and copper immerſed therein is ſaid to have been diſſolved into a blue liquor.

The three alkalies mentioned above as ſaturated with aerial acid, differ greatly from cauſtic al-

* Phil. Tranſ. 1767. † HENCHEL Bethesda port.
‖ BOMARE Dictionaire.

kalies,

kalies, in the mildneſs of their taſte, in their property of chryſtallizing, and in their effervescing with acids which expel the aerial acid, but they ſtill change vegetable blues to greens, though not ſo powerfully as the cauſtic alkalies do. Therefore, although the ſubtil aerial acid in other reſpects gives them neutral properties, yet in this it does it but imperfectly.

§ 57.

The compounds of earths and acids which poſſeſs ſolubility mentioned at § 20, are decompoſed and precipitated by mild, but not by phlogiſticated alkalies.

§ 58.

TERRA PONDEROSA *vitriolata*, (heavy ſpar, marmor metallicum, calk) is placed with the earths (§ 89.) Terra ponderoſa *nitrata* i. e. terra ponderoſa united to the nitrous acid, perhaps exiſts ſomewhere, but has never been met with; neither has the terra ponderoſa united to the *aerial* acid, yet been found†. Terra ponderoſa *ſalita* i. e. terra ponderoſa with the *muriatic acid* Mr.

† I have lately diſcovered a ſpecimen of TERRA PONDEROSA *aerata* got out of a mine in this kingdom. It is very pure, and in a large maſs. As this ſubſtance is a new acquiſition to mineralogy, and may be turned to uſeful purpoſes in Chemiſtry, I intend ſhortly to preſent a more particular account of it to the Royal Society. W.

HIELM

HIELM says ‡ is diſſolved in the waters of the lake Vettern and its neighbourhood.

§ 59.

CALX *vitriolata* (gypſum, ſelenite) is not only found diſſolved in various waters, but alſo in many places forms immenſe ſtrata. It is placed by all mineralogiſts amongſt the earths, but I think improperly. When burnt it generates heat with water, but in a leſs degree than lime does.

§ 60.

CALX *nitrata* (nitre of lime; terrene nitre) is ſometimes found in water, but very ſparingly. It is ſaid that the chalk hills in ſome parts of France become ſpontaneouſly impregnated with nitrous acid, which may be waſhed out, and after a certain time they will become impregnated with it again.

§ 61.

CALX *Salita* (fixed ammoniac) occurs very frequently in waters.

§ 62.

CALX *aerata* (marble, limeſtone, chalk, ſpar) is very commonly found diſſolved in waters in conſequence of an exceſs of the aerial acid. When it greatly abounds, the water is ſaid to be hard *(cruda)*. By boiling, or by evaporation, it depoſits ſtreaks or cruſts of calcareous matter.

‡ Conf. Præl. SCHEFFERI, § 188, not. 2.

Calx

Calx aerata is not ſoluble in water without an exceſs of the ſubtil acid, and therefore might properly be referred to the earths (§ 21).

§ 63.

MAGNESIA *vitriolata* (Epſom ſalt) is not unfrequent in the waters of England, Bohemia, and other countries. This ſalt is preſently decompoſed by lime water, which circumſtance readily diſtinguiſhes it from the alk. min. vitriol. or Glauber's ſalt.

§ 64.

MAGNESIA *nitrata* (magneſia and nitrous acid) is uſually found together with nitre.

§ 65.

MAGNESIA *ſalita* (magneſia and muriatic acid) is found diſſolved in various waters, but plentifully in ſea water, to which it gives a diſagreeable bitterneſs.

§ 66.

MAGNESIA *aerata* (common magneſia) with an exceſs of aerial acid it becomes ſoluble in cold water, otherwiſe it is ſcarce ſoluble at all, and therefore ſhould be claſſed with the earths. (§ 21.)

ARGILLA

§ 67.

ARGILLA *vitriolata* (alum) is ſometimes ſpontaneouſly generated by the decompoſition of pyrites lodged in clay, or in argillaceous ſchiſtus.

It is found in a ſpring at Steckenitz in Bohemia *, in Eaſt Bothnia and elſewhere. What is commonly called *plumoſe* alum is not a ſaline ſubſtance.

ARGILLA (clay) united to the *nitrous*, *muriatic* †, or aerial acids has not to my knowledge hitherto been found in any waters.

* Margraaf Kl. Schrift. tom. II. p. 191.

† I found it in conſiderable quantity in the Nevil Holt water, when I analyzed it ſix years ago; and it is probable that the Ballycaſtle water in Ireland, likewiſe contains it. W.

METALLIC

METALLIC SALTS.

§ 68.

THE native ſalts belonging to this diviſion, may be diſtinguiſhed by the phlogiſticated alkaly which precipitates them all. The few which have ſaline properties (§ 20.) we ſhall mention here, referring the reſt to the mineralized metals.

§ 69.

CUPRUM *vitriolatum* (vitriol of copper, blue vitriol) is found in the mines of Herregrund, Fahlune, and others which contain copper pyrites.

§ 70.

FERRUM *vitriolatum* (vitriol of iron, green vitriol) is formed from the decompoſition of the more common pyrites.

§ 71.

FERRUM *aeratum* (iron with aerial acid) diſſolved by an exceſs of acid in the lighter chalybeate waters.

FERRUM

FERRUM *nitratum*, and *ſalitum* (iron with nitrous and muriatic acids) have never yet been found native.

§ 72.

NICCOLUM *vitriolatum* (vitriol of Nickel) ſometimes exiſts from the decompoſition of ſulphureous ores of Nickel.

§ 73.

ZINCUM *vitriolatum* (vitriol of zinc, white vitriol) is ſometimes, though rarely, produced by the decompoſition of pſeudogalæna, or black Jack, becauſe this ſubſtance does not very readily decompoſe ſpontaneouſly.

§ 74.

* MANGANESIUM *ſalitum* (manganeſe united to muriatic acid) exiſts in ſome waters Mr. HIELM ſays.

Whether manganeſe be ever united to waters like iron, by means of an exceſs of aerial acid, we know not.

* In the original the word is MAGNESIUM, but it is here changed, by the advice of Dr. Swediar and the concurrence of profeſſor Bergman to MANGANESIUM, in order to prevent confuſion from its ſimilarity to Magneſia. W.

TRIPLE SALTS.

§ 75.

THE compound ſalts hitherto enumerated are ſuch as are compoſed of two ingredients only; but ſometimes three or more are ſo united as not to be ſeparated by chryſtallization. The vitriols that we are acquainted with are hardly ever pure, and two or three of them ſometimes are joined together.

Sometimes likewiſe it happens that neutral ſalts join earthy ſalts, and earthy ſalts metallic ones. I generally diſtinguiſh compound ſalts according to the number of their principles, whether the ſame acid be joined to ſeveral baſes, or the ſame baſis to different acids; or laſtly, whether ſeveral menſtrua and ſeveral baſes are joined together. Hence ariſe ſalts triple, quadruple, &c. which the diligence of after times muſt illuſtrate. I ſubjoin the moſt remarkable examples of triple and quadruple native ſalts which have occurred to me.

§ 76.

ALKALI MINERALE SALITUM (common ſalt) contaminated by *magneſia ſalita*. The common

mon ſalt when pure does not deliqueſce, but this degree of purity is ſeldom found, and in the native foſſil production *(ſal gem)* never.

§ 77.

MAGNESIA *vitriolata* (Epſom ſalt) contaminated by *ferrum vitriolatum*† (vitriol of iron.)

§ 78.

ARGILLA *vitriolata* (alum) *native*, contaminated by *vitriol of iron*. In the aluminous ſchiſtus it ſometimes efflores̊ces in a feathery form. Is this the plumoſe alum of the antients?

§ 78*.

ARGILLA *vitriolata* (alum) native; contaminated by ſulphur and vitriolic acid.

At the places about Wedneſbury and Bilſton, in Staffordſhire, where the coal pits are on fire, this ſubſtance ſublimes to the ſurface, and may be collected in conſiderable quantity during dry or froſty weather. I cannot be certain that this is a true chemical union, but the eye cannot diſtinguiſh the parts. Perhaps the ſulphur volatilizes the alum and ſo becomes intimately mixed with it. The exceſs of vitriolic acid keeps it in a deliqueſcent ſtate.

I believe a ſimilar compound ſubſtance ſublimes at the Solfaterra near Naples. W.

† Mr. MONNET de aquis mineralibus.

§ 79.

ARGILLA *vitriolata* (alum) native, contaminated by *vitriol of cobalt*. In the mines of Herregrund and Idra this may be ſeen, ſhooting out into long ſlender filaments. Perhaps this is the *trichites* of the Greeks. Diſſolved in water it immediately betrays the preſence of vitriolic acid, upon the addition of terra ponderoſa ſalita (muriatic acid ſaturated with heavy earth.) By the addition of phlogiſticated alkali a precipitate of cobalt is thrown down, which makes a blue glaſs with borax or microcoſmic ſalt.

§ 80.

CUPRUM *vitriolatum* (vitriol of copper) contaminated by *iron*.

§ 81.

FERRUM *vitriolatum* (vitriol of iron) contaminated by *nickel*.

§ 82.

CUPRUM *vitriolatum* (vitriol of copper) and vitriol of iron contaminated by *zinc*. Such is found at Fahlune.

CLASS

CLASS II.

EARTHS.

§ 83.

BEFORE we can underſtand the nature of earths, we muſt know their component parts. Thoſe earths which cannot be further decompoſed we call *primitive*, and thoſe which conſiſt of two or more of theſe intimately united, *derivative*. By this union we do not mean a mere mechanical diffuſion, at leaſt not ſuch as can be diſtinguiſhed by the eye, as is the caſe in ſtones, *(ſaxa.)*

§ 84.

It is evident that the primitive earths will conſtitute ſo many natural Genera, and different mixtures of theſe the Species.

They who would make ſeveral Genera out of one primitive earth, muſt ſeparate the glaſſy, red, white, horny ſilver ores, and other different compoſitions into as many Genera, or elſe act inconſiſtently with their own principles.

§ 85.

At preſent we only know five primitive earths. They who reckon fewer, reſt their opinions upon fanciful metamorphoſes unſupported by faithful

 experiments

experiments ‡. As experiments teach us that there are five primitive earths, it is evident that the Species ariſing from the mixture of theſe cannot exceed twenty-four, viz. 10 double (conſiſting of two earths) 6 triple, 3 quadruple, and the 5 primitive.

Although theſe different mixtures are poſſible, and probably do exiſt, they have not yet been all found. The natural compoſitions of acids with the earths, forming ſubſtances not ſoluble in 1000 times their weight of boiling water, and which may be called ſaline earths, muſt be added to the ſpecies, as they are certainly chemical combinations.

§ 86.

The primitive earths hitherto detected are,

TERRA PONDEROSA, or heavy earth.

CALX, - - - - - - calcareous earth.

MAGNESIA, - - - magneſia.

ARGILLA, - - - - argillaceous earth.

TERRA SILICEA, - - ſiliceous earth.

And we muſt believe theſe to be primitive, until it ſhall appear by proper experiments that they may be ſeparated into others ſtill more ſimple, or changed into one another by art.

‡ Opuſc. chem. vol. I. p. 394—399.

Theſe

Theſe are firſt to be conſidered in their greateſt ſimplicity and purity, although nature never preſents us with ſuch, nor can they even by art be rendered abſolutely free from all heterogeneous mixture. Water and aerial acid readily unite with the four firſt, and when expelled by fire, a little of the matter of heat is added, and remains until driven out by a more powerful attraction. But in this ſtate they poſſeſs a degree of purity not to be attained by any other known method. Therefore it is neceſſary to examine them when ſufficiently burnt in order to diſtinguiſh better what properties depend upon adhering heterogeneous matters.

HEAVY EARTH,

OR

TERRA PONDEROSA.

§ 87.

TO obtain this as pure as poſſible, the ſpathum ponderoſum § 89 (heavy ſpar) muſt be reduced to a fine powder, and with equal parts of fixed alkaly and charcoal duſt roaſted for an hour in a covered crucible. Powder the maſs, and add nitrous or muriatic acid diluted until all effervescence ceaſes, and the liquor be ſenſibly acid. To this liquor add mild fixed alkaly, and the heavy earth will be precipitated in a mild ſtate. If the acids or the alkaline ſalt contain any vitriolic acid, the heavy ſpar will immediately be regenerated. What remains undiſſolved by the acid is heavy ſpar, not decompoſed. The proceſs may be repeated upon this, but the product will then contain ſome martial earth and ſome clay from the crucible, therefore the firſt part will be the moſt pure.

§ 88.

TERRA PONDEROSA *aerata*, (heavy earth) has a specific gravity of 3, 773*. 100 parts of it contain about 28 of water, 7 of aerial acid, and 65 of pure earth. It effervesces with acids: with the vitriolic acid forms heavy spar, not soluble in water; with the nitrous and muriatic acids, it yields chrystals, not very readily soluble; but with the vegetable acid the chrystals deliquesce.

When free from all contamination of acid or alkaly it scarcely melts in the fire, but loses $\frac{3}{100}$ of its weight. When united with the matter of heat, (i. e. rendered caustic) it dissolves in 900 times its weight of water; and when this solution is exposed to the atmosphere, a cream or crust separates at the top, which effervesces with acids. After burning, it unites to acids without effervescence; but heat is produced, and the union is more tardy than when it is in a mild state †.

When caustic, it expells the volatile alkaly from sal ammoniac, and forms a hepar with sulphur, the watery solution of which is but imperfectly decomposed by the nitrous or muriatic acids,

* The author speaks here of such as he obtained by precipitation from acids, but the *native* TERRA PONDEROSA *aerata* (see note at page 28) has a specific gravity of nearly 4, 338. W.

† Opusc. vol. I. p. 21, 398.

upon

upon account of the remarkable attraction betwixt this earth and the acid of the sulphur, which it even takes from the vegetable alkaly‡.

When we compare these properties with those which belong to common calcareous earth, mentioned at (§§ 92, 93), we shall readily see wherein they agree, and wherein they differ.

§ 89.

TERRA PONDEROSA *vitriolata* (heavy spar) is full four times as heavy as an equal bulk of water. It dissolves entirely, though sparingly, in concentrated boiling vitriolic acid, but the addition of a single drop of water occasions a precipitation. The same thing happens to gypsum; but that requires much less acid to dissolve it, and the precipitation is made more slowly. If the heavy spar contained any sulphur, it must certainly have appeared when the whole was dissolved, but I never could find any thing like it.

CRONSTEDT, Min. § 18. 2.
Marmor metallicum druſicu § 19 C. Ponderous Spar.

§ 90.

TERRA PONDEROSA *vitriolata*, impregnated with bitumen, and mixed with gypsum, alum, and siliceous earth.

CRONSTEDT Min. § 24. *Lapis hepaticus.* Liver Stone.

‡ N. Acta Upſ. Vol. II. page 198.

A nu-

A nucleus of this kind, taken out of a piece of alum ore from Andrarum in the province of Skone, yielded, in 100 parts, by analysis, 33 of siliceous earth, 29 of caustic heavy earth, earth of alum about 5, and quick-lime from 3 to 7, besides the water and vitriolic acid. By calculation it appears, that these bases, together with vitriolic acid enough to saturate them, ought to weigh 71, which, with the addition of 33, exceeds the amount of the original 100. This increase points out the difference of a mass newly chrystallized, and of one carefully dried.

§ 91.

When we consider that the terra ponderosa was altogether unknown before the year 1774, and that many mineralogists are even now unacquainted with it, we cannot wonder that we know so few species of it. I have scarce a doubt but the *terra ponderosa aerata* may be found mixed with other earths in many specimens, when they come to be examined by chemical means more accurately than they could be heretofore. (See notes to §§ 58 and 88.)

CALCAREOUS

CALCAREOUS EARTH,

OR

CALX.

§ 92.

AS calcareous earth united to the aerial acid is found native, it requires but little trouble to have it pure. Let ſelected pieces of chalk, reduced to fine powder, be repeatedly boiled in pure water: this diſſolves any calx or magneſia ſalita which it may contain. This done, it holds no heterogeneous matter but what mechanically adheres to it, the quantity of which is generally extremely ſmall. If we deſire to be free from this likewiſe, diſſolve the waſhed chalk in diſtilled vinegar, precipitate with volatile alkaly, and after waſhing the precipitate well, dry it.

§ 93.

The ſpecific gravity of calcareous earth thus purified, is 2,720. 100 parts of it contain about 34 of aerial acid, 11 of water, and 55 of pure earth.

Acids unite with it effervеſcing, and a centenary (centenarius) excites about 22 degrees of heat

heat. The vitriolic acid forms gypſum, difficult to diſſolve, (59). The nitrous and muriatic acids form deliqueſcent ſalts (§§ 60, 61), and the acetous acid permanent chryſtals.

Pure calcareous earth does not melt in the fire, but loſes $\frac{45}{100}$ of its weight. It diſſolves in 700 times its weight of water, generating heat*. Acids diſſolve it, producing from a centenary 252 degrees of heat, but without any efferveſcence. This laſt circumſtance may be beſt obſerved by immerging the burnt earth in water, to diſſipate a part of the heat, which would otherwiſe make the acid boil. The water likewiſe expels the atmoſpheric air from the pores of the lime. In this ſituation, if nitrous or muriatic acid be poured upon it, and if it was previouſly well burnt, no efferveſcence will take place. The ſolution proceeds ſlowly†, but the ſaturation becomes as perfect as if the calcareous earth had been in a mild ſtate. This burnt earth, or lime, expels the volatile alkaly from ſal ammoniac in a cauſtic ſtate, and it diſſolves ſulphur; but this compound is ſeparated upon the addition of any acid, even the aerial.

§ 94.

Amongſt the native Species of this genus, we muſt firſt mention the CALX *aerata* (marble, lime-

* Opuſc. chem. vol. I, page 23.

† Opuſc. chem. vol. I, page 398.

ſtone

ſtone, chalk) which conſtitute immenſe ſtrata. Its chief properties are enumerated above (§ 92). It is very rarely found entirely free from iron, which exiſts even in the pureſt Icelandic ſpar, and indeed in almoſt every foſſil production; upon which account only the more remarkable impregnations with iron will be noticed in the following pages.

CRONSTEDT Min. §§ 5---12.

§ 95.

CALX *aerata* (calcareous earth *mild)*, with more or leſs *petroleum*. It effervesces with acids, and diſſolves; with the vitriolic acid frequently turning brown. Is fœtid when heated or rubbed. The oil is not in ſufficient quantity to be collected, by diſtillation, in drops; it only fouls the inſide of the veſſels, unleſs a very great quantity be operated upon. In an open fire the colour preſently vaniſhes, from the petroleum drying up. It generally contains a portion of martial clay.

CRONSTEDT Min. §§ 22, 23. *Lapis ſuillus*. Fœtid ſtone.

§ 96.

CALX *fluorata* (calcareous earth and *fluor acid)*, when pure, is wholly ſoluble in nitrous and muriatic acids. Expoſed to heat, below ignition, it emits a phoſphoreſcent light. Fluor acid, dropped into lime water, precipitates a powder which has

has all the properties of the calx fluorata. It is ſometimes, but not always, contaminated by a ſmall proportion of ſiliceous earth and muriatic acid.

CRONSTEDT Min. §§ 97---101. *Sparry fluor.* Blue John.

§ 97.

CALX (calcareous earth) ſaturated with a *peculiar acid*, perhaps of a metallic nature (§ 33). In acids, particularly in the muriatic, it aſſumes a remarkable yellow colour, but is not very ſoluble.

CRONSTEDT Min. § 210. Lapis ponderoſus. Tungſten.

§ 98.

CALX *aerata* (calcareous earth *mild*), contaminated by a ſmall proportion of *magneſia ſalita*. Magneſia.

§ 99.

CALX *aerata* (calcareous earth *mild*) contaminated by *clay*. Argillaceous.

§ 100.

CALX *aerata* (calcareous earth *mild*), contaminated by *ſiliceous earth*. Siliceous.

CALX

§ 101.

CALX *aerata* (calcareous earth *mild*), contaminated by *clay* and *ſiliceous earth*. (See § 115.)

CRONSTEDT Min. §§ 25. 28. Calcareous Marle.

§ 102.

CALX *aerata* (calcareous earth *mild*), contaminated by *iron* and *manganeſe*. Martial.

CRONSTEDT Min. § 30. See alſo § 203. *Hæmatites.*

§ 103.

There can be no doubt that the four firſt (§§ 94--97.), if not the laſt (§ 102), are genuine and diſtinct ſpecies; there is ſome difficulty as to the reſt, dependent, perhaps, only upon mechanical mixtures. If the heterogeneous matters can be diſcerned by the eye, we cannot heſitate to refer the ſubſtance to the ſaxa (ſtones); but in theſe the eye cannot diſcern them. Moreover, we know that the earths have a mutual attraction to each other, and form combinations more intimate than mechanical ones. Earth of alum, precipitated by a cauſtic alkali, and thrown into lime water, preſently loſes its pellucid and ſpongy texture, turns white, and condenſes, abſorbing the lime from the water, and forming an union not to be ſeparated but by chemical means.

From

From theſe conſiderations, I dare not venture to exclude doubtful ſpecies.

We ſay a thing is *contaminated* by another, when the mixture is of the mechanical kind; but when things are joined by the ſtronger power of attraction, we ſay they are *united*.

MAGNESIA.

§ 104.

MAGNESIA, called in the dispensatories, and by apothecaries *magnesia alba*, is a precipitation from its union with vitriolic acid, called Epsom salt. If this earthy precipitate be wanted in the greatest degree of purity, the Epsom salt must be taken chrystallized, and well depurated, dissolved in distilled water, and precipitated by volatile alkaly. Let the liquor be boiled for a few minutes, in order that what is kept in solution by the aerial acid may subside.

§ 105.

Magnesia, thus obtained, has a specific gravity of 2,155. 100 parts of it contain about 25 of aerial acid, 30 of water, and 45 of earth‡. It dissolves in acids, with a violent effervescence, but without heat. It again forms Epsom salt, with the vitriolic acid; with the nitrous acid it chrystallizes, but the chrystals are deliquescent; with the muriatic and vegetable acids it does not chrystallize, and after drying, greedily attracts moisture from the atmosphere.

‡ Opusc. chem. vol. II. p. 29, 373.

It

It does not melt in a moderate heat, but loſes $\frac{55}{100}$ of its weight, and then has no attraction for water; diſſolves ſlowly, even in acids, and that without efferveſcence, but with ſome degree of heat. After calcination, it expels the volatile alkaly from ſal ammoniac, and unites to ſulphur, though very feebly.

MAGNESIA *aerata* (common magneſia) is never found native and unconnected, unleſs in waters, when it is diſſolved by an exceſs of aerial acid. (§ 66.)

§ 106.

MAGNESIA *aerata* (common magneſia) united with *ſiliceous* matter. This efferveſces with acids, and not unfrequently ſtrikes fire with ſteel.

§ 107.

MAGNESIA intimately united with *ſiliceous* matter. The ſoluble part is ſlowly taken up by acids, without efferveſcence.

CRONSTEDT Min. §§ 75---83. and perhaps § 102—105 alſo; but I have not yet ſubmitted the aſbeſti to the liquid analyſis. *Soaprock. Serpentine.*

§ 108.

MAGNESIA united to *argillaceous*, *ſiliceous*, and *pyritical* matters.

M. MONNET diſcovered this, and the next ſpecies.

§ 109.

MAGNESIA united to *argillaceous*, *siliceous*, and *pyritical* matters, and likewise contaminated by petroleum.

This species resembles aluminous schistus, but upon examination is found to contain more magnesia than clay.

§ 110.

All the species, except the first, are more or less contaminated by iron, but they do not owe all their colour to this substance. The green colours altogether vanish during ignition, and leave only a white opake mass.

ARGIL-

ARGILLACEOUS EARTH,

OR

ARGILLA.

§ 111.

BY earth of alum (argilla) I do not mean common clay, which is never free from ſiliceous matter, but a pure clay, unmixed, at leaſt, with any other earth. It may be readily obtained by diſſolving Roman or roach alum in diſtilled water, filtering, and precipitating by mild volatile alkaly.

§ 112.

The ſpecific gravity of this pure clay, or earth of alum, is 1,305. It diſſolves in acids, with a little effervescence. With the vitriolic acid it forms alum; with the nitrous, muriatic and vegetable acids, deliqueſcent ſalts.

When dry, it abſorbs water greedily, becomes ſoft, and, with a due quantity of water, gains ſuch a tenacity, that it may be moulded at pleaſure. This maſs contracts greatly in the fire, from whence ariſe numerous cracks; and with a due

degree of heat, it becomes hard enough to ſtrike fire with ſteel. By this burning it loſes its glutinous tenacity, and the water is excluded by the approach of the particles; nor does it again aſſume its former properties, but by ſolution and precipitation.

It may be diſſolved in the dry way, by means of fixed alkaline ſalt, as well as in the liquid way, by acids. The vitriolic acid is better than the others for this purpoſe, becauſe more eaſily concentrated.

Earth of alum neither diſſolves ſulphur, nor decompoſes ſal ammoniac.

§ 113.

ARGILLA (argillaceous earth) united to *ſiliceous* matter only.

CRONSTEDT Min. §78. *Argilla porcellana.* Porcelain clay. Pipe clay.

I never examined any clay which did not contain a large quantity of ſiliceous earth; generally more than half its weight*.

* Profeſſor *Bergman* does not here ſeem to be ſufficiently aware of the difference between our Devonſhire pipe clay, and that which is uſed in the manufacture of porcelain. The former, in an open fire, burns to a blueiſh grey, or pidgeon

§ 114.

ARGILLA (argillaceous earth) united to *ſiliceous* and *irony* matter.

CRONSTEDT Min. §§ 87 and 90. Bole. Dye-earth. Clay.

§ 115.

ARGILLA (argillaceous earth) united to *ſiliceous* and *calcareous* matter.

CRONSTEDT Min. § 25. *Marga argillacea.* Marle.

§ 116.

ARGILLA (argillaceous earth) united to *ſiliceous* earth and *magneſia*.

CRONSTEDT Min. §§ 84, 4. B. Terra lemnia.

Its component parts reſemble thoſe of talc, but differ in their proportions, and are alſo leſs intimately united.

colour; the latter remains white. The former ſeems to be the ſame as the Cologne and Maeſtricht pipe clay, of Cronſtedt, § 78; the latter is a decayed Feldſpath, and conſequently, according to our author, (§ 130) contains magneſia. Our porcelain clay, likewiſe, has quartz, chryſtals, and mica mixed with it, parts of the granite which it originally compoſed. Before it is uſed the quartz is ſeparated, but the mica remains. I am indebted to my friend Mr. Watt for theſe obſervations. W.

§ 116*.

ARGILLA (argillaceous earth) united to *ſiliceous*, *calcareous*, and *magneſia* earths.

Lithomarga. (†) CRONSTEDT Min. § 84. A.
Stone marrow.

§ 117.

ARGILLA (argillaceous earth) contaminated by *vegetable alkaly* and *ſulphur*, or at leaſt by the acid of ſulphur.

CRONSTEDT Min. § 124. 2. b. Minera aluminis romani.
Alum ore.

It certainly contains vitriolic acid ‡, and perhaps, alſo, a ſmall portion of ſulphur. The vegetable alkaly ſufficiently ſhews its volcanic origin.

§ 118.

ARGILLA (argillaceous earth) contaminated by *ſiliceous* matter, *pyrites*, and *petroleum*.

CRONSTEDT Min. § 124. 2. c. *Schiſtus aluminaris* ||.
Alum ſlate.

† I have taken the liberty to add this ſpecies upon our author's own authority. See BERGMAN Diſſ. de Lithomarga, page 13.

‡ N. Acta Upſal. vol. III, page 121.

|| Opuſc. vol. I, page 291, 292.

ARGIL-

§ 119.

ARGILLA (argillaceous earth) intimately united with *leſs than half its weight of ſiliceous* earth, and a ſmall quantity of *mild calcareous* earth.

CRONSTEDT Min. §§ 43---48. Gemma.

The Gems ſuffer no change under the blow-pipe, with foſſil fixed alkaly, but are diſſolved by microcoſmic ſalt and borax.

To this head belong *Rubinus*, the ruby;
Saphirus, - ſapphire;
Topazius, topaz;
Smaragdus, emerald.

The *tourmaline* holds a kind of middle place betwixt the gems and the ſcherle. The colour, in all of them, is owing to iron.

§ 120.

ARGILLA (argillaceous earth) intimately united to *half its weight of ſiliceous earth* (or more), and a little *mild calcareous* earth. Scherle.

CRONSTEDT Min. §§ 68---71. *Granatus et Baſaltes*, which I call *Scherle*.

The remote varieties of theſe are eaſily diſtinguiſhed, the near ones difficultly.

ARGIL-

§ 121.

ARGILLA (argillaceous earth) loosely united to half its weight, or more, of *siliceous* earth, and a little *calcareous* earth.

CRONSTEDT Min. §§ 108---112. *Zeolithus.* Zeolite.

There is a great affinity betwixt this and Scherle; but in the zeolite, the component parts cohere so loosely, that acids attach and separate them without their being previously treated with alkalies; but this is not the case with the scherles.

Zeolite, contaminated by magnesia, I have not yet examined.

§ 122.

ARGILLA (argillaceous earth) intimately united to a large proportion of *siliceous* earth, and a small proportion of *magnesia*.

CRONSTEDT Min. §§ 93---96. *Mica. Talcum.* * Glimmer. Talc.

* It is probable, that in another edition, the author may see reason to separate the *mica* from the *talc*; as some experiments I have made, though yet too imperfect for publication, seem to indicate the necessity of such a measure. W.

SILICEOUS EARTH,

OR

TERRA SILICEA.

§ 123.

THIS, like the other primitive earths, is ſeldom found pure. In order to have it ſo, reduce clear quartz chryſtals into powder; melt it with four times the weight of fixed alkaly; diſſolve the whole in water; precipitate by a large quantity of ſtrong acid; carefully waſh and dry the precipitate.

The acid muſt be uſed in a ſuperfluous quantity, that any other earths contained may be diſſolved.

§ 124.

The ſpecific gravity of this earth, is 1,975. The particles, when firſt precipitated, occupy, in water, at leaſt twelve times the ſpace that they do when dried; ſo that, when ſufficiently fine, they may remain ſuſpended therein; nay, when vehemently heated in a cloſe veſſel, they may be diſſolved. No acid, except that of fluor ſpar

(§ 30) has any action upon this earth. Fixed alkalies unite with it in the liquid way, but in the dry way they seize it with great vehemence, and convert twice their weight of it into a permanent transparent glass. Such is its affinity to alkalies, that it imparts to clay, which is always loaded with it, the power of separating some of the acid from nitre and common salt. When pure, it is refractory in the fire.

Although siliceous earth is not altogether simple, yet, in mineralogy, it must be considered as primitive, until decisive experiments shew us from which of the preceding earths it is derived†.

§ 125.

TERRA SILICEA (siliceous earth) united to very small quantities of *calcareous* and *argillaceous* earth.

CRONSTEDT Min. § 51. *Quartzum:* Quartz.

§ 126.

TERRA SILICEA (siliceous earth) united to *argillaceous* earth.

CRONSTEDT Min. § 58, *Calcedonius.* Chalcedony.

And perhaps the *Opal.* The *Hydrophanus* is only a variety of these.

† Opusc. vol. II. p. 49.

Whether

Whether the *carnelian*, and other *silicæ*, of finer or coarſer texture, belong to this or the preceding ſpecies I cannot yet determine with certainty.

§ 127.

TERRA SILICEA (ſiliceous earth), united to an *argillaceous* and highly *martial* earth.

CRONSTEDT Min. §§ 64, 65. *Jaſpis.* Jaſper.

§ 128.

TERRA SILICEA (ſiliceous earth), loaded with *martial* earth. Martial.

CRONSTEDT Min. § 53.

This ſpecies is often called jaſper, but improperly, becauſe it contains no argillaceous earth.

§ 129.

TERRA SILICEA (ſiliceous earth), united to *argillaceous* and a ſmall quantity of *calcareous* earth.

CRONSTEDT Min. § 63. Petroſilex. Chert.

§ 130.

TERRA SILICEA (ſiliceous earth) united to *argillaceous* earth and a little *magneſia.*

CRONSTEDT Min. § 66. *Feldſpathum.* Feld ſpat.

§ 131. TERRA

§ 131.

TERRA SILICEA (ſiliceous earth), united to *magneſia*, mild *calcareous* earth, *fluor ſpar* and alſo to the *calxes* of *copper* and *iron*. Chryſoprafius. I have not examined this, but inſert it upon the experiments of Mr. Achard.

To determine accurately the ſpecies of earths is the moſt difficult part of mineralogy, for innumerable analyſes yet remain to be made. But that which now ſeems intricate and obſcure will become plain and eaſy when experiments have been ſufficiently multiplied.

CLASS

CLASS III.

INFLAMMABLES,

OR

BITUMINA.

§ 132.

TO this head we refer all foſſils containing phlogiſton in ſuch great abundance, that under proper management they are inflammable. The Genera are obviouſly very few, and accurately ſpeaking there is only one Genus. But ſince phlogiſton is ſo very ſubtle as not by itſelf to become the object of our ſenſes, it will perhaps be adviſeable to conſider its more ſimple combinations as Genera: this has long been done ſo far as reſpects the metals, by univerſal conſent.

SULPHUR

SULPHUR.

§ 133.

THIS name may be given to any acid coagulated by phlogiſton into a ſolid form. If all metals conſiſt of certain radical acids ſaturated with phlogiſton, as is highly probable, and with reſpect to arſenic is indubitably proved; then metals ought to find a place here. But until this theory be eſtabliſhed by numerous experiments, we ſhall only rank under this head the compounds which have not a metallic nature.

§ 134.

PHLOGISTON ſaturated with *vitriolic acid.*

CRONSTEDT, Min. § 151. *Common Brimſtone.* Sulphur.

§ 135.

PHLOGISTON ſaturated with *aerial acid.*

CRONSTEDT Min. § 154. A. *plumbago.* Black-lead.

The true compoſition of this has been detected by Mr. SCHEELE.

§ 136. PHLO-

§ 136.

PHLOGISTON united to the *acid* of *vitriol* and of *molybdæna*; or what amounts to the ſame, ſulphur joined to the acid of molybdæna.

CRONSTEDT Min. § 154. b. c. *Molybdæna.* Molybdæna.

The acid of molybdæna has never yet been obtained quite free from phlogiſton (§ 32). If this acid be of a metallic origin, molybdæna is a mineralized metallic ſubſtance, and ſhould be placed with the other minerals.

PETROLEUM.

§ 137.

PHLOGISTON occurs alſo in the foſſil kingdom, combined in an oily form; but many ſuppoſe this derived from the vegetable kingdom.

§ 138.

PETROLEUM pure and ſelected.

CRONSTEDT Min. §§ 147---150. Naptha. Rock oil.

§ 139.

PETROLEUM joined to *argillaceous* earth.

CRONSTEDT Min. §§ 157---160. *Lithantrax*. Pit Coal.

§ 140.

PETROLEUM united to *acid* of *amber*.

CRONSTEDT Min. §§ 133---146. *Succinum*. Amber.

Many contend that amber has a vegetable origin; but as the point is not very well determined; and as it is found amongſt foſſils, I ſtill retain it here.

AMBER-

§ 141.

AMBERGRISE, according to the aſſertion of Mr. AUBLETT, is nothing more than the juice of a tree inſpiſſated by evaporation into a concrete form. This tree grows in Guyana, and is called Cuma, but has not been inveſtigated by any botaniſt. Pieces of this tree are ſaid to be carried down into the rivers by heavy rains, and the ſpecimens examined by Mr. ROUELLE had the odour and principal qualities of amber†. RUMPHIUS, long ſince, mentioned a tree called Nanarium, whoſe juice reſembled amber*.

† Hiſt. des Plantes de la Gujane. 1774.

* Dr. SWEDIAR lately preſented a paper to the Royal Society, from which it appears highly probable that Ambergriſe is nothing but the indurated fæces of the Sperma Ceti whale, who feeds upon the cuttle fiſh. He has found the beaks of that fiſh intermixed with the ambergriſe, in the form of black ſpots. W.

DIAMOND.

§ 142.

AT first sight I may seem to have acted erroneously, by separating this from the other gems, and inserting it here; but after due consideration, I know not where to place it better. It has never yet been decomposed by the liquid analysis ‖; and when exposed to the fire in an open vessel, it is wholly consumed, burning with a lambent flame. This deflagration, though slow, shews decidedly its affinity to the inflammables: besides, in the focus of a burning glass, it leaves traces of soot †. When further experiments teach us better, I shall willingly correct my error.

‖ Opusc. Vol. II, page 112.

† *Lavoisier*, Mem. de l'Acad. de Paris.

CLASS IV.

METALS.

§ 143.

I Have before mentioned the great affinity betwixt metallic and inflammable ſubſtances (§ 133). Zinc and arſenic ſtand, as it were, upon the borders betwixt them; for theſe, in proper circumſtances, burn with a very evident flame. All the metallic ſubſtances contain phlogiſton, and when, to a certain degree, deprived of it, fall into a powder like an earth; but their attractions for phlogiſton are different. Moſt of them, when melted in a common way, and expoſed to the air, have an earthy cruſt formed upon the ſurface, which cannot again be reduced to metal without the addition of ſome inflammable matter. The *baſe* metals, eleven in number, have this property: but the *noble* metals, platina, gold and ſilver, are ſo firmly connected to the phlogiſton, that they never calcine under fuſion, however long continued; and after being changed into a calx in the liquid way, when melted in the fire, they re-aſſume their metallic form, without any other phlogiſton than what is contained in the matter of heat.

Quickſilver holds a kind of middle place; for, like the baſe metals, it may be calcined, though not

not readily; and like the noble ones, it may be reduced by heat alone.

I have placed each diviſion of the metals in the order of their ſpecific gravities.

Thoſe metals, which are found in a perfect metallic ſtate, are called *native*; thoſe united to acids, or to ſulphur, are ſaid to be *mineralized*; and thoſe which are only deprived of their phlogiſton, *calciform* †.

† Opuſc. vol. II. page 275.

TABLE

TABLE OF METALS.

METALS.	Specific Gravity.	Melting Heat*.	Saturating Phlogiſton.	Attraction to ſaturating Phlogiſton.
Gold	19,640	1301	394	1 or 2
Platina	27,500		756	1 or 2
Silver	10,552	1000	100	3
Quickſilver	14,110	-39 or -634	74	4
Lead	11,352	595	43	10
Copper	8,876	1450	312	8
Iron	7,800	1601	342	11
Tin	7,264	415	114	9
Biſmuth	9,670	494	57	7
Nickel common	7,000	1301	156	11
Nickel pure	9,000	1601		
Arſenic	8,308		109	5
Cobalt common	7,700	1450		
Cobalt pure		1601		
Zinc	6,862	699	182	11
Antimony	6,860	809	120	6
Manganeſe	6,850	very great	227	11

* The degrees of heat here expreſſed, are according to Farenheit's ſcale.

By *ſaturating phlogiſton*, Profeſſor Bergman means to expreſs the proportionate quantities taken away from each metallic ſubſtance, when diſſolved by means of acids, and of courſe reduced to a calciform ſtate. The laſt column only expreſſes their attractions to this part of their phlogiſton, not to that which ſtill remains united to them in a calciform ſtate. W.

AURUM,

OR

GOLD.

§ 144.

THE ſpecific gravity of this metal, when pure, is 19,640. Aqua regia diſſolves it; but except the dephlogiſticated muriatic acid, and in certain circumſtances the nitrous, no ſimple acid acts upon it, unleſs it has been previouſly calcined *. The quantity of phlogiſton neceſſarily taken away in the ſolution of 100 parts of gold, I eſtimate at about 394; whilſt the ſame quantity of ſilver, loſes by ſolution in the nitrous acid, 100 †. Gold retains the phlogiſton neceſſary to its metallic form, more obſtinately than any other metal, except, perhaps, platina. It melts and calcines in the focus of a burning glaſs at 1301 degrees of heat.

§ 145.

AURUM *nativum* (gold native) united to *ſilver*. Native

* Opuſc. Vol. II. page 374---376.

† Diſſertatio de quantitate Phlogiſti in diverſis metallis.

I do

I do not know that gold has ever yet been found perfectly pure.

§ 146

AURUM *nativum* (gold native) united to *copper*. Native.

§ 147.

AURUM *nativum* (gold native) united to *silver* and *copper*. Native.

§ 148.

AURUM *nativum* (gold native) united to *silver*, *copper*, and *iron*. Native.

§ 149.

AURUM (gold), mineralized by *sulphur*, by means of iron. Pyritical.

CRONSTEDT Min. § 166. a. *Pyrites aureus.*

But some doubt may be made about the mineralization of gold *.

* Opusc. chem. vol. II, page 411.

AURUM

§ 150.

AURUM (gold) mineralized by *ſulphur*, together with *ſilver*, *lead*, and *iron*.

Minera aurifera Nagyayenſis.

I have not yet fully examined this ‖.

‖ Opuſc. chem. Vol. II, page 413.

PLATINUM,

PLATINUM,

OR

PLATINA.

§ 151.

ITS ſpecific gravity is 18,000*, when very pure. It diſſolves in aqua regia, and the loſs of phlogiſton during the ſolution, according to the experiments hitherto made may be ex-

* From ſome late experiments made upon platina by the Count de SIKENGEN, and publiſhed in German by profeſſor Succow, it appears that the ſpecific gravity of pure platina is 27,500. When perfectly pure and in its metallic ſtate it was not calcined by deflagration with nitre, it did not admit of being hardened or ſoftened by tempering, like ſteel or other metals; it was drawn into a wire $\frac{1}{170}$ of a line in diameter; this wire admitted of being flattened, and had more ſtrength than a wire of gold or ſilver of the ſame ſize. This platina is not fuſible by the ſtrongeſt fire, but melts in the focus of a burning glaſs; its colour white, ſhining like fine ſilver.

From conſidering the very intereſting experiments of the Count de Sikengen, I apprehend the following method to obtain pure and malleable platina will be found a good one.

Diſſolve the grains of native platina that are leaſt magnetic, in aqua regia. Precipitate the iron by means of phlogiſticated fixed alkaly. Then precipitate whatever elſe will fall, by cauſtic vegetable alkaly. Saturate the liquor with cauſtic foſſil alkaly, and ſet it by to chryſtallize. The yellow chryſtals thus obtained are to be hammered together at a welding heat, and the metallic parts will unite. W.

preſſed

preſſed by 756. Beſides the muriatic acid, which when dephlogiſticated diſſolves every metal, no acid acts upon platina without it has undergone a previous calcination. It ſeems to retain its phlogiſton more obſtinately than any other metal. To melt it requires a heat greater than that at which iron melts.

§ 152.

PLATINA *native* united to *iron*. Native.

CRONSTEDT Min. § 179.

I believe it has never been found quite free from iron, but this can be ſeparated by art †.

† Opuſc. chem. vol. II, page 181.

ARGENTUM

ARGENTUM,

OR

SILVER.

§ 153.

ITS ſpecific gravity is 10,552. The nitrous acid readily diſſolves it, the vitriolic muſt be boiling hot; the muriatic attracts its calx very ſtrongly, but cannot remove its phlogiſton and therefore cannot diſſolve it in its metallic ſtate. The quantity of this phlogiſton which cauſes the difference betwixt its metallic and its calciform ſtate I before expreſſed as 100 in 100 parts of ſilver. But the force with which it retains this portion of its phlogiſton is leſs than that of gold; that is, it occupies the third place in a ſeries of all the metals. It melts at 1000 degrees of heat.

§ 154.

ARGENTUM *nativum* (ſilver native) united to *gold*. Native.

§ 155.

ARGENTUM *nativum* (ſilver native), united to *copper*. Native.

AR-

§ 156.

ARGENTUM *nativum* (ſilver native), united both to *gold* and *copper*. Native.

§ 157.

ARGENTUM *nativum* (ſilver native), united to *iron*. Native.

§ 158.

ARGENTUM *nativum* (ſilver native), united to *arſenic*. Native.

The arſenic hardly exceeds $\frac{6}{100}$.

§ 159.

ARGENTUM *nativum* (ſilver native), united to *antimony*. Native.

When melted, it ſmokes but has no ſmell of arſenic.

§ 160.

ARGENTUM *nativum* (ſilver native), united to *arſenic* and *iron*. Native.

The

The three metallic ingredients are nearly in equal proportions.

All the ſpecies hitherto mentioned have metallic properties and appearances. The contaminating matters are ſometimes extremely ſmall, but not to be neglected when they exceed $\frac{1}{300}$ part of the maſs.

§ 161.

ARGENTUM (ſilver) mineralized by the *vitriolic* and *muriatic* acids. Horn-like.

CRONSTEDT Min. §177. *Minera argenti cornea.* Horn-ſilver

Mr. WOULFE*, detected the preſence of the vitriolic acid. The ſilver ſeldom exceeds $\frac{70}{100}$. I know not whether it is ever altogether free from vitriolic acid.

§ 162.

ARGENTUM (ſilver), mineralized by the *vitriolic* and *muriatic* acids, and *ſulphur.*

I doubt whether this be a diſtinct ſpecies, ſince the ſulphur and the ſalts ſcarcely admit of any other than a mechanical union.

* Phil. Tranſ.

AR-

§ 163.

ARGENTUM (ſilver), mineralized by ſulphur. Glaſſy.

CRONSTEDT Min. § 169, *Minera argenti vitrea.*

It ſometimes contains $\frac{75}{100}$ of ſilver, or more.

§ 164.

ARGENTUM (ſilver), mineralized by *ſulphur* and *iron.* Marcaſitical.

CRONSTEDT Min. § 176, 10. *Pyrites argenteus.*

§ 165.

ARGENTUM (ſilver), mineralized by *ſulphur* and *lead.* Potters.

CRONSTEDT Min. § 176, 8. *Galena.*

The ſilver is only a few half ounces in a hundred weight.

§ 166.

ARGENTUM (ſilver), mineralized by *ſulphur* and *arſenic.* Red.

CRONSTEDT Min. § 170. *Minera argenti rubra.*

It

It contains about $\frac{70}{100}$ of ſilver. Iron is frequently preſent, as in moſt other ſpecies but not always.

§ 167.

ARGENTUM (ſilver), mineralized by *ſulphur*, *arſenic*, and *iron*. Glittering.

CRONSTEDT Min. § 172.

I have examined ſome ſpecimens from Saxony which ſometimes contain no ſilver. May we not therefore ſuppoſe that the ſilver is native and not mineralized?

§ 168.

ARGENTUM (ſilver), mineralized by *ſulphur*, *arſenic*, *iron* and *cobalt*.

The ſilver is ſometimes more than $\frac{50}{100}$.

§ 169.

ARGENTUM (ſilver), mineralized by *ſulphur*, *arſenic*, *copper* and *iron*. White ore.

CRONSTEDT Min. § 171. *Minera argenti alba.*

The proportion of ſilver varies much, ſometimes it is $\frac{10}{100}$ or more.

§ 170.

ARGENTUM (ſilver), mineralized by *ſulphur, arſenic, copper, iron,* and *antimony*. Grey ore.

CRONSTEDT Min. § 173. 6. Minera argenti griſea. In the province of Dal *.

It contains $\frac{24}{100}$ of copper, ſeldom $\frac{5}{100}$ ſilver.

§ 171.

ARGENTUM (ſilver), mineralized by *ſulphur, arſenic, antimony* and *iron*. Plumoſe.

CRONSTEDT Min. § 173. 5. *Federertz of the* Germans †.

It ſeldom contains more than a few half ounces of ſilver in the hundred weight.

It is abſurd to found ſpecies upon the differences of the matrix: theſe ought to be conſidered elſewhere.

* This reference is not to be found in the Engliſh edition of Cronſtedt. I imagine it ſhould be § 174. 6. where it is called the Dal Falertz. W.

† In this reference too I ſuſpect a miſtake. It ought I believe to be 173, 6. W.

HYDRAR-

HYDRARGYRUM,

OR

QUICKSILVER.

§ 172.

ITS ſpecific gravity is 14,110. It has been erroneouſly ranked among the brittle metals, for at 654 degrees below 0 it freezes*, and then ſpreads under the hammer like lead. But as ſuch an extreme degree of cold rarely happens unleſs artificially produced, we ceaſe to wonder why it is always liquid or rather melted.

Nitrous acid diſſolves it readily, virriolic acid requires to be aſſiſted by a boiling heat; muriatic acid does not act upon it all, unleſs previouſly deprived of as much phlogiſton as in 100 parts may be called 74. The attractive power wherewith it retains this portion of phlogiſton occupies the fourth place in the ſeries; that is, it holds it leſs ſtrongly than the noble but more ſtrongly than the baſe metals.

* Some late experiments made at Hudſon's Bay ſeem to prove that Quickſilver congeals and becomes malleable at 39 degrees below 0. See Lond. Med. Journal, page 205, for the year 1783. W.

§ 173.

HYDRARGYRUM *nativum* (quickſilver native). Native.

CRONSTEDT Min. § 217.

Whether it be entirely free from every metallic contamination I have not yet tried.

§ 174.

HYDRARGYRUM (quickſilver), united to *ſilver*. Amalgamated.

CRONSTEDT Min. § 217.

§ 175.

HYDRARGYRUM (quickſilver), mineralized by *muriatic* and *vitriolic* acids. Hornlike.

Mineralogy owes the diſcovery of this to Mr. WOULFE. Phil. Tranſ.

§ 176.

HYDRARGYRUM (quickſilver), mineralized by *ſulphur*. Cinnabarine.

CRONSTEDT Min. § 218. *Cinnabaris.*

HY-

§ 177.

HYDRARGYRUM (quickſilver), mineralized by *ſulphur* and *iron*. Martial.

I am doubtful whether this be a diſtinct ſpecies. The iron perhaps is only mechanically diffuſed.

§ 178.

HYDRARGYRUM (quickſilver), mineralized by *ſulphur* and *copper*. Cuprous.

CRONSTEDT Min. § 219.

PLUMBUM,

OR

LEAD.

§ 179.

ITS ſpecific gravity is 11,352, greater than that of any other of the baſe metals. The nitrous acid perfectly diſſolves it; the muriatic more difficultly; the vitriolic hardly at all, for the vitriol of lead being inſoluble in water incruſts the metal, and prevents its ſolution. After calcination the weakeſt vegetable acids diſſolve it, and acquire a ſweet taſte. The phlogiſton neceſſary to be taken away in order that it may diſſolve may be called 43, which is leſs than that of any other metal. Hence we underſtand why the calx of lead may be reduced with a very minute quantity of inflammable matter. With reſpect to the force wherewith it retains this phlogiſton it occupies the tenth place. It melts at 595 degrees of heat.

§ 180.

PLUMBUM *nativum* (lead), though many mineralogists doubt whether it has ever yet been found. Native.

§ 181.

PLUMBUM (lead), mineralized by *vitriolic acid*. Vitriol of.

Originating from the decomposition of Galena. It is rarely met with. It was first observed by Mr. Monnet. It does not effervesce with acids. It may be reduced by the blowpipe upon charcoal.

§ 181*.

PLUMBUM (lead), mineralized by *vitriolic acid* and *iron*.

Existing in immense quantity in the island of Anglesea. It does not reduce with the blowpipe upon charcoal, but melts to a black glass*. W.

* When I introduce a new *species* I repeat the preceding number, with the addition of an asterisk, rather than break in upon the order of the author's numbers. I intend shortly to publish an exact analysis of this substance. W.

§ 182.

PLUMBUM (lead), mineralized by the *acid* of *phoſphorus*. Phoſphorated.

This was diſcovered by Mr. GAHN. It does not effervesce with acids. It melts upon charcoal with the blow-pipe, but is not perfectly reduced.

§ 183.

PLUMBUM (lead), mineralized by the *aerial* acid. Aerated.

CRONSTEDT Min. § 185.

It effervesces with acids, and is readily reduced upon charcoal ‖.

§ 184.

PLUMBUM (lead), mineralized by *ſulphur*. Sulphurated.

CRONSTEDT Min. § 187.

§ 185.

PLUMBUM (lead), mineralized by *ſulphur* and *ſilver*. Galena.

CRONSTEDT Min. § 188.

‖ Opuſc. chem. vol. II, page 426.

PLUMBUM

§ 186.

PLUMBUM (lead), mineralized by *ſulphur*, with *ſilver* and *iron*.

CRONSDEDT Min. § 189.

§ 187.

PLUMBUM (lead), mineralized by *ſulphur*, with *ſilver* and *antimony*. Radiated.

CRONSTEDT Min. § 190.

CUPRUM

CUPRUM,

OR

COPPER.

§ 188.

ITS ſpecific gravity is 8,876. Nitrous acid diſſolve it readily, muriatic acid ſlowly, and the vitriolic requires intenſe boiling. The phlogiſton, ſeparated in the ſolution of 100 parts, may be expreſſed by 312. The weakeſt vegetable acids act upon it, eſpecially after calcination, and ſo do alkalies, the volatile alkaly eſpecially. With reſpect to the power with which it retains the phlogiſton, copper holds the eighth place. It melts with 1450 degrees of heat.

§ 189.

CUPRUM *nativum* (copper native). Native. CRONSTEDT Min. § 193.

It is rarely found without ſome alloy of gold, ſilver or iron; but I have not yet fully examined it.

CUPRUM

§ 190.

CUPRUM *calciforme* (copper), ſimply deprived of its phlogiſton. Calciform.

CRONSTEDT Min. § 195.

§ 191.

CUPRUM (copper), mineralized by *muriatic acid* and *argillaceous earth*. Micaceous.

Mr. WERNER, in his tranſlation of Cronſtedt's Mineralogy, part 1, page 217, has deſcribed it accurately, and kindly ſent me a ſpecimen of it, which I analyſed *.

§ 192.

CUPRUM (copper), mineralized by the *aerial acid*. Aerated.

CRONSTEDT Min. §§ 194, 196. b. 3.

Mr. FONTANA firſt pointed out its true compoſition. It contains about $\frac{2}{3}$ of copper, $\frac{1}{3}$ or $\frac{1}{4}$ of aerial acid, and a little water †.

* Opuſc. vol. II. page 431.

† Opuſc. chem. vol. II. p. 429.

CUPRUM

§ 193.

CUPRUM (copper), mineralized by *ſulphur.*
Vitreous.

CRONSTEDT, Min. § 197. *Minera cupri vitrea*; a common, but improper name.

It generally contains ſome alloy of iron.

§ 194.

CUPRUM (copper), mineralized by *ſulphur*, and a ſmall proportion of *iron.*

CRONSTEDT Min. § 198, b. Minera cupri lazurea.

By a *ſmall proportion* of iron, I mean leſs than the weight of the copper; by a large proportion, more. This contains from 40 to 50 per cent. of copper.

§ 195.

CUPRUM (copper), mineralized by *ſulphur*, and a large proportion of *iron.* Pyritical.

CRONSTEDT Min. § 198. *Pyrites Cupri.*

The quantity of copper varies greatly, but ſeldom exceeds $\frac{40}{100}$.

CUPRUM

§ 196.

CUPRUM (copper), mineralized by *ſulphur, iron* and *arſenic*. Grey.

CRONSTEDT Min. § 198. a. *Pyrites cupri griſeus.*

This frequently contains an alloy of ſilver. The copper rarely exceeds $\frac{6}{100}$.

FER-

FERRUM, OR IRON.

§ 197.

ITS ſpecific gravity is 7,800. All the acids readily diſſolve it; but the vitriolic muſt be diluted, otherwiſe it may be boiled almoſt to dryneſs, without effecting it. The phlogiſton, diſlodged from 100 parts of ductile iron, may, as experiments now ſtand, be called 342; and this is ſo feebly retained, that this metal, with a few others, holds the eleventh, or loweſt place in the ſeries.

It requires an intenſe degree of heat to fuſe it, viz. 1601, if the uſual compariſon betwixt the mercurial thermometer, and the metallic one of MORTIMER, be true. Iron is red hot at 1050 degrees of heat.

§ 198.

FERRUM *nativum* (iron) *native.* Native.

It

It can hardly be doubted, but that the great mass of iron, brought by PALLAS, from Siberia, into Europe, is the produce of nature. Its composition resembles that of forged iron; for 100 parts of it yield, by means of the muriatic acid, 49 cubic inches of inflammable air; and from many experiments upon ductile iron, that is found to yield from 48 to 51 *.

§ 199.

FERRUM *nativum* (iron) *native*, united to arsenic. Arsenical.

CRONSTEDT Min. § 243. B. *Mispickel.*

§ 200.

FERRUM (iron), with the power of attracting other iron. Loadstone.

CRONSTEDT Min. § 211. b. *Magnes.*

The cause of this property is yet unknown.

§ 201.

FERRUM (iron), with phlogiston enough to render it magnetic. Magnetic.

CRONSTEDT Min. §§ 212, 214.

* Diss. de Analysi ferri.

But

But the quantity of phlogiſton is far ſhort of that which is neceſſary to render it ductile, for a centenary hardly contains more than three cubic inches of inflammable air.

§ 202.

FERRUM *calciforme* (iron calciform), ſimply deprived of phlogiſton. Ochrous.

CRONSTEDT Min. §§ 202---206. *Bloodſtone.*

§ 203.

FERRUM (iron), mineralized by *aerial acid*, *calcareous earth*, and *manganeſe*. White.

CRONSTEDT Min. § 90. *Minera ferri alba.*

§ 204.

FERRUM (iron), mineralized by *ſulphur*. Pyritical.

CRONSTEDT Min. § 152. *Pyrites.*

§ 205.

FERRUM (iron) intimately united to a new brittle metal †, or to a peculiar modification of iron, rendering it brittle when cold. Cold-ſhort.

In cold-ſhort iron, a brittle metal exiſts, readily uniting to ductile iron, by the aſſiſtance of heat, but rendering it brittle when cold. This ſubſtance, diſſolved in acids, forms Pruſſian blue with phlogiſticated alkaly, but it is not magnetic: it

† Called Sideritis, from its reſemblance to iron. W.

affords

affords a white calx, richer in phlogiſton than the yellow calx of good iron.

I hope, by more experiments, ſoon to become better acquainted with it.

§ 206.

FERRUM *calciforme* (iron calciform), *phlogiſticated* in a peculiar manner. Blue.

CRONSTEDT Min. § 203. *Cæruleum berolinenſe nativum.*

Clay and mould are ſometimes coloured ſuperficially by a dilute blue, and ſometimes the former, when newly dug up, is found to acquire this colour upon expoſure to the air. It is evident that the baſis of this colour is an irony matter, full of phlogiſton; for, by ignition upon a charcoal fire, it flames, turns red, and becomes magnetic. With a gentle heat it becomes green, but when melted gives black ſcoriæ.

Alkalies, as well as acids, diſſolve it, and the colour vaniſhes, but appears again, if precipitated from the former by acids, and from the latter by alkalies; but it has then a greeniſh caſt, and ſoon becomes white. This white ſediment, immerſed in an infuſion of galls, or of tea, recovers its former colour.

From what has been ſaid, it appears that this colour, although analogous to the artificial Pruſſian blue, differs from it in its intenſity, in the mode of its production, and in various properties. It keeps its colour in water, but turns black with oil.

STANNUM,

OR

TIN.

§ 207.

ITS ſpecific gravity is 7,264. Vitriolic, muriatic, acetous acids, and aqua regia, diſſolve it, but the nitrous, eſpecially when ſtrong, attacks it ſo violently, that it ſoon reduces it to the ſtate of an inſoluble calx.

The quantity of phlogiſton it loſes by ſolution, may be called 114; and this it retains with a force that gives it the ninth place in the ſeries. It melts eaſier than any metal, except quickſilver, viz. at 415 degrees.

§ 208.

STANNUM *nativum* (tin). Native.

This I have not ſeen. Some doubts are entertained of its true nature, and, perhaps, not without reaſon.

STAN-

§ 208*.

STANNUM *ſulphuratum* (tin), mineralized by *ſulphur*. Sulphurated.
[See the Preface.]

§ 209.

STANNUM *calciforme* (tin) calciform, contaminated by *iron*. Calciform.

VISMUTUM,

OR

BISMUTH.

§ 210.

THE heavieſt of all the brittle metals that follow it, its ſpecific gravity being 9,670. Nitrous acid, and aqua regia diſſolve it perfectly. The vitriolic acid muſt be boiled nearly to dryneſs before it acts upon it, and the muriatic acid only attacks its calx. The quantity of phlogiſton which reſiſts the action of menſtrua, is expreſſed by 57; and its power of retaining it ranks it in the ſeventh place. It melts at the heat of 494 degrees.

§ 211.

VISMUTUM *nativum* (biſmuth). Native.

CRONSTEDT Min. § 222.

§ 212.

VISMUTUM *calciforme* (biſmuth). Calciform.

CRONSTEDT Min. § 223.

I am

I am not able to ſay whether this is merely deprived of its phlogiſton, or whether it is not alſo mineralized by aerial acid.

§ 213.

VISMUTUM (biſmuth) mineralized by *ſulphur*. Sulphurated.

CRONSTEDT Min. § 224.

§ 214.

VISMUTUM (biſmuth) mineralized by *ſulphur* and *iron*. Pyritical.

CRONSTEDT Min. § 225.

NICCOLUM,

OR

NICKEL.

§ 215.

THE regulus, when depurated, has a ſpecific gravity of 9,000, or more; but the common regulus, obtained by the firſt reduction, little exceeds 7,000. Aqua regia, and nitrous acid, diſſolve it perfectly; muriatic acid, ſlowly; vitriolic acid, not without boiling almoſt to dryneſs; and the acetous acid does not act upon it, unleſs in a calciform ſtate. The quantity of phlogiſton ſeparated by ſolution, may be called 156; and this it retains with a force about equal to that with which iron retains its phlogiſton (§ 197).

The heat neceſſary to melt it, is about equal to that which gold requires; but when depurated, it is almoſt as difficult to melt as iron.

The properties of it are more fully examined elſewhere‡.

‡ Opuſc. chem. vol. II. p. 231.

NIC-

§ 216.

NICCOLUM *nativum* (nickel) native, united to *iron* and *arsenic*. Native.

It sometimes, perhaps, contains cobalt. As it contains neither sulphur nor mineralizing acid, and is perfectly in its metallic form, it must be called *native*, although joined to other metals.

§ 217.

NICCOLUM *aeratum* (nickel) mineralized by *aerial acid*. Aerated.

CRONSTEDT Min. § 255.

§ 218.

NICCOLUM (nickel) mineralized by *sulphur*, *arsenic*, *cobalt*, and *iron*. Mineralized.

CRONSTEDT Min. § 256. Cuprum Nicolai. Kupfer nickel.

ARSENICUM,

OR

ARSENIC.

§ 219.

THE ſpecific gravity of the radical acid, is 3,391; of white arſenic, 3,706; of its glaſſy ſtate, 5000; and its regulus, 8,308. Aqua regia, and muriatic acid, diſſolve it perfectly; the vitriolic acid requires boiling; the acetous acts only upon its calx: the nitrous acid not only takes away as much phlogiſton as may be expreſſed by 109, deprived of which the regulus is reduced to the ſtate of a calx, but in a large quantity, aſſiſted by a proper degree of heat, it at length ſo far dephlogiſticates this calx, as to leave the acid of arſenic alone. Theſe phænomena are well worthy of obſervation, as they ſeem to lay open the nature of metals in general. From analogy, it is probable that every metal contains a radical acid of a peculiar nature, which, with a certain quantity of phlogiſton, is coagulated into a metallic calx; but with a larger quantity, ſufficient to ſaturate it, forms a compleat metal. The radical acid retains the coagulating phlogiſton much more ſtrongly

ſtrongly than that which is neceſſary to the ſaturation. But different metallic acids retain both with different degrees of attraction. Hence the noble metals cannot be calcined in the dry way; it is only by acid menſtrua that they can be brought into that form; but all the others loſe their ſaturating phlogiſton in the fire, though with more or leſs difficulty. I have diſtinctly obſerved eleven different degrees of reſiſtance: thus, gold may be precipitated by all the other metals, except perhaps platina, which I think may thus be explained. The calx of gold having the greateſt attraction for phlogiſton, takes it from all other metals, and thus loſing its ſolubility falls down in a metallic ſtate. Therefore gold in the ſeries of metals, occupies at leaſt the ſecond place. Platina is precipitated by all, but leſs evidently than gold. To this therefore, I think we muſt give the firſt place, and ſo on of the others as I have remarked in the character of each metal. As nickel, cobalt, iron, manganeſe and zinc, do not precipitate one another, they are put together in the laſt and eleventh place *.

In order to obtain the radical acids we muſt ſeparate them from the coagulating phlogiſton. If the induſtry of chemiſts ever effects this, I am confident that metallurgy will be wonderfully elucidated. This therefore is a taſk to which

* Diſs. de quantitate phlogiſti in metallis.

our

our labours muſt be directed. I know that analogy muſt be cautiouſly truſted, but it at leaſt leads us to new experiments. Hitherto this operation has only ſucceeded with arſenic; and it is worth notice, that this metal which holds the fifth place with reſpect to its quantity of phlogiſton, ſhould be inferior to all others with regard to the attraction by which the coagulating quantity is retained.

Arſenic melts, but the moment it ſuffers heat enough to melt it, it volatilizes, unleſs it be firſt calcined. The regulus thrown upon a plate of iron properly heated, preſently takes fire and calcines, diffuſing a ſmell like garlic *.

§ 220.

ARSENICUM *nativum* (arſenic), native, united to iron. Native.

CRONSTEDT Min. § 239.

I have never found it free from martial impregnation.

§ 221.

ARSENICUM *nativum* (arſenic), native, united to ſilver.

* Opuſc. chem. vol. II, p. 272.

ARSEN-

§ 222.

ARSENICUM *calciforme* (arſenic), deprived of phlogiſton. Calciform.

CRONSTEDT Min. § 240.

§ 223.

ARSENICUM (arſenic), mineralized by *ſulphur*. Yellow.

CRONSTEDT Min. § 241. *Auripigmentum. Riſigallum.*

§ 224.

ARSENICUM (arſenic), mineralized by *ſulphur* and *arſenic*. Pyritical

CRONSTEDT Min. § 243. A. *Pyrites arſenicalis.*

COBALTUM

COBALTUM,

OR

COBALT.

§ 225.

ITS ſpecific gravity is 7,700. Nitrous acid and aqua regia readily diſſolve it. The vitriolic acid requires to be boiled nearly to dryneſs. The muriatic and acetous acids do not act upon it unleſs previouſly calcined. 270 expreſſes the quantity of ſaturating phlogiſton, which it retains with the ſame force that iron does. Common regulus melts in the ſame heat that copper does, but when well purified it is hardly eaſier to melt than iron.

§ 226.

COBALTUM *nativum* (cobalt), native and united to *arſenic*. Native.

CRONSTEDT Min. § 249.

§ 227.

COBALTUM *calciforme* (cobalt). Calciform.

CRONSTEDT Min. § 247.

It is found variouſly mixed, principally with arſenic, iron and copper, but whether mechanically or by a more intimate union I know not.

CO-

§ 228.

COBALTUM (cobalt), mineralized by acid of *arſenic.* Red.

CRONSTEDT Min. § 248.

The ſmall ſpecimens that I have been able to examine point out ſuch a compoſition*.

§ 229.

COBALTUM (cobalt), contaminated by *iron* and *vitriolic acid.* Vitriolic.

CRONSTEDT Min. § 250.

§ 230.

COBALTUM (cobalt), mineralized by *ſulphur, arſenic* and *iron.* Glanz-cobalt.

CRONSTEDT Min. § 251.

§ 231.

COBALTUM (cobalt), mineralized by *ſulphur, arſenic, iron* and *nickel.* Kupfernickel.

CRONSTEDT Min. § 252.

* Opuſc. chem. vol. II, p. 446,

ZINCUM

OR

ZINC.

§ 232.

ITS ſpecific gravity is 6,862. All the acids diſſolve it readily and with effervescence, which denotes its very lax union with the inflammable principle, as was remarked before (§ 219). 182 expreſſes the quantity of phlogiſton it loſes in ſolution. It melts in a heat of 699 degrees; and if the heat be a little increaſed it takes fire; and diſſipates in white flowers*.

§ 233.

ZINCUM *calciforme* (zinc), calciform ſimply deprived of its phlogiſton. Calciform.

CRONSTEDT Min. § 228. A. *Lapis calaminaris.*

It is almoſt always mixed with clay or calciform iron.

* Opuſc. Vol. II, page 309.

ZINCUM

§ 234.

ZINCUM (zinc), mineralized by *aerial acid.* Aerated.

CRONSTEDT Min. § 228. A. 1.

§ 235.

ZINCUM (zinc) with *aerial acid* and mixed with *ſiliceous* matter. Siliceous.

D. A. BORN ſent me chryſtals of this ſpecies, which expoſed to the fire gave out aerial acid, but they were not wholly ſoluble in acids.

§ 236.

ZINCUM (zinc), mineralized by *ſulphur* and *iron.* Black jack.

CRONSTEDT Min. §§ 229. 230. *Pſeudogalena*

ANTI-

ANTIMONIUM

OR

ANTIMONY.

§ 237.

ITS ſpecific gravity is 6,860. Aqua regia diſſolves it well; vitriolic acid requires boiling; muriatic and acetous acids act hardly at all upon it, unleſs previouſly calcined. The nitrous acid corrodes it ſo as to prevent the ſolution. The phlogiſton it loſes in ſolution is expreſſed by 120, and with reſpect to the force wherewith it retains this, it ſtands in the ſixth place. It melts at a heat of 809 degrees.

§ 238.

ANTIMONIUM *nativum* (antimony). Native.

CRONSTEDT Min. § 238.

ANTI-

§ 239.

ANTIMONIUM (antimony), mineralized by ſulphur. Sulphurated

CRONSTEDT Min. § 234.

§ 240.

ANTIMONIUM (antimony) mineralized by ſulphur and arſenic. Red.

CRONSTEDT Min. § 235.

MANGANESIUM

OR

MANGANESE.

§ 241.

ITS ſpecific gravity is 6,850. This new metal is ſoluble in all the acids, and is ſo readily deprived of its ſaturating phlogiſton that with iron and ſome others it ſtands the loweſt in the ſeries. 227 expreſſes the quantity of phlogiſton it loſes in ſolution. It is very difficult to melt, more ſo than iron.

§ 242.

MANGANESIUM *calciforme* (manganeſe) ſimply deprived of phlogiſton.

Calciform.

CRONSTEDT Min. § 114.

MAN-

§ 243.

MANGANESIUM (manganese) mineralized by *aerial acid.*

Aerated.

CRONSTEDT Min. § 115. 1. 2.

APPENDIX

THE FIRST.

§ 244.

IN the preceding pages only the more ſimple combinations occur, whoſe principles are either chemically united or at leaſt ſo ſubtly interwoven that the texture appears perfectly homogeneous. But if two or more of theſe ſpecies, forming little diſtinct maſſes are cemented together, theſe mechanical mixtures, diſcernible by the eye ought to conſtitute a new ſeries, to be diſtinguiſhed by their component parts as the others were by their firſt principles or chemical elements. Such compoſitions may well be excluded from the preſent work, but upon account of their extenſive phyſical, œconomical and metallurgical uſes, I propoſe to give a ſlight ſketch of them here, enumerating the more remarkable Genera.

§ 245.

In a general view it appears that not only ſeveral ſpecies cemented together may be referred to this place, but likewiſe thoſe which are mechanically diffuſed in a powdery or an earthy form.

From

§ 246.

From the laws of combination it is evident, that according to the arrangement of foſſils into four claſſes, there can be only TEN Genera compoſed of two, FOUR of three, and ONE of four conſtituent parts. And although ſo many have not yet been detected, yet it is better to mention them here as the induſtry of a future age will probably diſcover more. The ſpecies are formed from the differences of the more ſimple ſpecies and their component parts.

Salts *with* Salts.

§ 247.

This compoſition can hardly ever conſtitute a genus, if it muſt be made in a dry and concrete form; for excepting gypſum, the other native ſalts readily diſſolve in water, and by evaporation are ſo mixed together as not readily to be diſcerned by the eye. Yet the foſſil alkaly mixed with common ſalt will perhaps find a place here. The contents of mineral waters may likewiſe be referred here, ſince every material difference in them depends upon the particles diſſolved.

Salts *with* Earths.

§ 248.

This mixture is hardly to be found but where bits of gypſum are concreted to matters of an earthy nature.

Salts *with* Inflammables.

§ 249.

May perhaps be found in volcanoes.

Salts *with* Metals.

§ 250.

If gypſum forms the matrix of any metal, it muſt be placed here.

Earths *with* Earths.

§ 251.

To this head belong moſt of the *ſaxa* (ſtones), enumerated by Mr. Cronſtedt, which form the immenſe bulk of mountains, and deſerve our particular attention, in order that, being better acquainted with the nature and ſtructure of the ſhell of the earth, we may be able to point out the coverings of minerals, and convert them all to our uſe.

Earths

Earths *with* Inflammables.

§ 252.

Lumps of mountain pitch are frequently connected with ſtones, and ſulphureous matters are found diffuſed through earthy materials.

Earths *with* Metals.

§ 253.

This genus contains the peculiar *matrices* of *metals*, a judicious conſideration of which would be particularly uſeful to miners.

Inflammables *with* Inflammables.

§ 254.

Perhaps, in ſome places, ſulphureous matters are found mixed with mountain pitch.

Inflammables *with* Metals.

§ 255.

If plumbago (black lead) or common ſulphur, ſhall ever be found mixed with metallic ſubſtances, ſuch ſpecies muſt ſtand under this genus.

Metals *with* Metals.

§ 256.

We know that ſome metals, in the boſom of the earth, are almoſt always mixed, whilſt others are rarely, or never, found together. A more accurate knowledge of theſe things, would illuſtrate phyſical geography, as well as metallurgy.

We now proceed to the more compound genera.

Salts *with* Earths *and* Inflammables.

§ 257.

This genus can hardly ever occur but in countries formerly expoſed to ſubterranean fires. †

Salts *with* Earths *and* Metals.

§ 258.

To be expected amongſt volcanic productions.

† Some of the ſulphur and alum, ſublimed by the ſubterranean fires near Bilſton, contain ſiliceous earth. W.

Salts

Salts *with* Inflammables *and* Metals.

§ 259.

To be ſought for in the productions of volcanoes.

Earths *with* Inflammables *and* Metals.

§ 260.

Obvious amongſt the productions of volcanoes, otherwiſe extremely rare.

Salts *with* Earths, Inflammables, *and* Metals.

§ 261.

Hardly to be expected but in volcanic mountains.

APPENDIX THE SECOND.

§ 262.

FOSSILS externally reſembling animals or vegetables, originate from foreign matters, which by ſome peculiar proceſs are changed in the boſom of the earth, or are ſo impregnated by mineral particles gradually occupying the place of thoſe which have putrified, that they no longer reſemble organic ſubſtances, except in figure.--- Theſe are commonly called PETREFACTIONS.

§ 263.

The harder ſhells of animals expoſed to the weather, are not always exempt from deſtruction; for their gelatinous matter being gradually deſtroyed by putrefaction, they become brittle, and in a manner calcined. In leſs expoſed ſituations, ſome of them preſerve the nature of their materials, but acquire a ſpar-like texture.

§ 264.

We muſt carefully diſtinguiſh betwixt the foreign bodies themſelves, changed or petrified, and their impreſſions upon the ſurrounding matrices. Sometimes

Sometimes the body is entirely deſtroyed, forming a cavity in the ſurrounding matter, and this cavity afterwards is filled with other materials. Nuclei, or kernels, are likewiſe found, formed within the cavities of the harder ſhells, and bearing the form of their internal ſurface.

§ 265.

I am far from thinking the knowledge of petrefactions is barren and uſeleſs. We may, and ought, to conſider them as medals depoſited by the hand of nature, in memory of the more remarkable changes on the ſurface of the earth, and from which the time and order of the work may, in ſome meaſure, be judged of, whilſt other monuments are ſilent. Theſe, being properly interpreted, ſhew us their native ſituations in the former ſtate of the ſurface of the earth, and teach us the unbounded empire of the ſea, and the conſequent changes. By them we learn to diſtinguiſh the ancient and modern foundations of the mineral kingdom; for thoſe which are not formed of petrefactions, and never contain them, are doubtleſs of greater antiquity than animals or vegetables; and, laſtly, by their figure they ſhew us the inhabitants of our globe, eſpecially thoſe of the greateſt depths of the ocean.

§ 266.

Mr. CRONSTEDT has admirably arranged the petrefactions; we think it right, therefore, to retain his method. The Genera are built upon the Genera

Genera of foſſils, and arranged like the four claſſes thereof; the ſpecies upon their ſpecies, and the varieties upon the organic ſubſtances that have been changed. The following are the Genera hitherto diſcovered.

Saline Calcareous Earth with an *organic Form.*

§ 267.

Gypſeous petrefactions are very rare.

Saline Iron with an *organic Form.*

§ 268.

Human bodies have ſometimes been found indurated and penetrated by vitriol of iron; ſo likewiſe have plants, their roots eſpecially. In the open air they moulder away.

Mild Calcareous Earth with an *organic Form.*

§ 269.

This conſtitutes the ſubſtance of moſt petrefactions.

Clay

Clay with an *organic Form.*

§ 270.

It is remarkable, that petrefactions found in clay are compreſſed, although, in ſubjacent calcareous ſtrata, they preſerve their natural figure. Similar compreſſed petrefactions are alſo found in the marly ſchiſtus.

Siliceous Earth with an *organic Form.*

§ 271.

Siliceous petrefactions are ſometimes met with, but, in general, this material forms only nuclei (§ 264). Trunks of trees are ſometimes found changed into agate. The celebrated FERBER has ſeen petrefactions in chert and jaſper, and the illuſtrious BORN mentions corallines (porpitæ) in ſinople or martial jaſper.

Earth organic.

§ 272.

Animals and vegetables are reſolved by putrefaction into an earth, which may be regarded as forming a peculiar genus, until every appearance of organization being obliterated, at length it comes to be conſidered as common earth.

Petro-

Petroleum impregnating *organic Bodies.*

§ 273.

Wood, penetrated by indurated petroleum, forms a remarkable variety of coal.

Silver with an *organic Form.*

§ 274.

Native ſilver is ſometimes inherent in petrefactions, but never, to my knowledge, conſtitutes the ſubſtance of them, unleſs mineralized with copper and ſulphur.

Quickſilver in an *organic Form.*

§ 275.

When mineralized by ſulphur, it ſometimes, though very rarely, conſtitutes petrefactions.

Copper with an *organic Form.*

§ 276.

Bones and teeth are ſometimes found replete with the blue calx of copper. Bits of copper pyrites often ſtick in petrefactions, but ſeldom conſtitute their whole ſubſtance. I have ſome ſuch from Norway, in a matrix of magnetical iron ore.

Iron

Iron with an *organic Form.*

§ 277.

Calciform iron ſometimes is found in the ſhape of roots and branches of trees. When mineralized by ſulphur, it frequently exiſts in petrefactions, but ſeldom conſtitutes the whole maſs.

Zinc with an *organic Form.*

§ 278.

I have ſeen pſeudo-galena (black jack), in the form of coral.

§ 279.

Some modern writers, as well as Mr. CRONSTEDT, place the productions of *volcanoes* in an appendix by themſelves; but, I think, to no good purpoſe. Things formed by the hand of nature, whether by a liquid or a dry proceſs, muſt not be disjoined; for ſhe frequently avails herſelf of both methods in one and the ſame inſtance. And, indeed, the origin of many things is ſo very doubtful, every veſtige thereof being obliterated, that even an Œdipus could not with certainty determine how they were produced. And, on the other hand, many aſſert, that almoſt the whole of the mineral kingdom is the product of fire. To avoid

avoid error, therefore, it is better to claſs foſſil ſubſtances according to their conſtituent parts, which proper experiments will lay open to us; for we can ſeldom know their origin or formation.

Homogeneous ſubſtances joined together, but not primitive, will find a place among the ſtones, or elſewhere, in the firſt appendix.

FINIS.

INDEX.

N. B. *The Numbers refer to the Sections.*

Chal-

Magnes

INDEX.

ERRATA.

Page 9, n. for Dr. WERNER, read Profeſſor WERNER.
15, line 23, for VANDELL, read VANDELLI.
21, line 10, for red, read green.
41, line 9, for acidor, read acid or.
71, line 5, for 27,500, read 21,000.
75, note —— 27,500, read 21,000.
95, line 1, for 100 parts, read centenary.
97, line 7, for berolineuſe read, Berolinenſes.